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**IMPLEMENTING ADVANCED TECHNOLOGIES IN
THE REPUBLIC OF CHINA AIR FORCE OFFICER
TRAINING SYSTEM**

by

I-Hsiu Yin

March 1994

Thesis Advisor:

S.S. Liao

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IMPLEMENTING ADVANCED TECHNOLOGIES IN THE REPUBLIC OF
CHINA AIR FORCE OFFICER TRAINING SYSTEM

by

I-Hsiu Yin

BS, Chinese Air Force Academy, 1981

Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN SYSTEMS MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

Rapid advances in the level of technology in education and training have greatly increased possibilities for their use. This thesis investigates traditional and more recent applications of advanced technology.

The goal of the work is to provide an introduction to concepts and considerations in implementing advanced technologies in education and training applications. Included is a model proposal for implementing advanced technologies in the Republic of China Air Force.

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I. INTRODUCTION

The Air Force of the Republic of China of Taiwan, known as the Chinese Air Force or CAF, has long employed extensive training programs for its officers. These training programs have served the CAF well, and with recent advances in the area of education and training technologies, an opportunity is presented to move toward a more efficient and cost-effective method of training for the twenty-first century.

Total Quality Management (TQM) and Total Quality Leadership (TQL) have been actively pursued in both the private and government sectors on Taiwan. One aspect of TQM/TQL that is regarded as essential in the continuing process of improvement is training. Traditional training methods, however, require extensive duplication of resources when personnel requiring training are in geographically diverse locations. Another complication of training demands in a military environment is the fact that training must continue while readiness of the armed forces is maintained. Recent advances in technology can be applied in training programs to increase their efficiency and allow training goals to more effectively be met.

The concept of distance education and training is not new. For years, many individuals have obtained education through correspondence courses. Currently, distance education is accomplished through a variety of media. Video-based instruction is widespread in the United States and around the world. The Education Broadcasting

Station and the Chinese Television System (CTS) broadcast cultural and educational programs daily for the general public. Courses on the "School of the Air" are available anywhere from the senior high to junior college or university level. Credit is given to participants who take and pass monthly examinations sponsored jointly by CTS and designated schools.¹

The development of affordable computer technology has lead to further developments in the area of distance education and training. The next anticipated phase of communications will employ the "information superhighway," whereby the masses have access to computer-mediated information in an interactive environment.

While the ultimate development of the ideal interactive training system may be some distance from a reality, there exists currently an affordable, efficient approach to design of training and evaluation systems that employ advanced technologies. It is the purpose of this thesis to explore advances in education and training technologies in order to propose the implementation of such technologies in programs for the training of CAF officers.

In pursuing that goal, Chapter II discusses the current officer training system employed by the CAF. In addition to a description of training and evaluation procedures, Chapter II presents information on the organization of the CAF, the structure of the existing CAF computer system, and general information on the fields of activity available to those who pursue a career as an officer in the CAF. Chapter III includes discussion of the various advanced technologies that are being integrated into the processes of

¹ Government Information Office, *The Republic of China Yearbook*, Taipei, 1993.

education and training. Chapter IV presents the reader with considerations that must be dealt with in implementing such technologies as part of an education or training program. Chapter V is a broad proposal for the integration of advanced technologies in the CAF officer training program. A multi-phase schedule for implementing technologies across four levels of training is included in this chapter, along with information on development requirements, suggested structures through which to implement and maintain the programs, and additional applications for, and benefits derived from, advanced training and education technologies. Finally, Chapter VI offers conclusions and recommendations.

This thesis is not meant to be a technical analysis of the technologies explored, and references to technical issues such as equipment and development requirements are given only to illustrate the concepts involved. *It must be understood that technically qualified individuals would have to be involved in any implementation of advanced technology in a training system to precisely determine its requirements and resulting capabilities.*

II. CAF OFFICER TRAINING

A. BACKGROUND

The Republic of China Air Force (CAF) was formed in 1936. At the beginning, the CAF was composed of about 500 personnel, and possessed only 36 aircraft. Today, the CAF includes 55,000 enlisted personnel and 35,000 officers, and maintains a fleet of over 500 aircraft.² The membership of the CAF includes enlisted personnel, who are recruited primarily through conscription (a small percentage are volunteers), and commissioned officers, who are volunteers. The length of service for draftees is two years, but enlisted personnel may elect to make a career of the service. Officers, if their abilities and performance warrant, usually complete a twenty year career in the Air Force.

At the present time, the CAF maintains 10 installations. In addition to the Air Force Headquarters at Taipei, there are nine other installations located around the island (see Figure 1). Air bases are located in the cities of Taoyuan, Hsinchu, Taichung, Chiayi, Tainan, Pingtung, Taitung, and Hualian. The Operational Headquarters of the CAF is also located in Taipei, while the Logistics Headquarters and the Air/Ground Defense Headquarters are located in Tainan and Taoyuan, respectively. The CAF Academy, the Air Technical School, and the Air Communications and Electronics School are located in Kwusun.

² Ministry of National Defense, *The National Defense Report*, Taipei, 1992.



Figure 1. CAF installations.

Like many armed forces throughout the world, the CAF is currently stressing efficiency. Budgetary pressures compel the Air Force leadership to spend less. At the same time, however, advances in technological capabilities compel the military

leadership to acquire new systems of their own. These combined pressures result in a demand for efficiency in every action. Advanced technologies provide the means to achieve efficiency in training systems, as well as the potential for related implementations in other areas of activity.

B. AIR FORCE ORGANIZATION

The organization of the Chinese Air Force is depicted in Figure 2. At the top of the organization chart is the CAF General Headquarters, which maintains singular command of all Air Force units. Further command levels are subdivided into other operations or logistics and support. The structure of the CAF also includes the Air Academy and the CAF's two technical training schools, the Air Technical School and the Air Communications and Electronics School. Aerial defense is a critical concern in Taiwan. Organized under the Operations Command are seven Tactical Fighter Wings and five independent squadrons, one Transport/Antisubmarine Wing, one Tactical Control Wing, the Air Defense Artillery and Post Guard Command, one Communications Wing, and one Weather Forecasting Wing. Organized under the Air Force Logistics Command are three logistical support divisions, one fuel group, two transport stations, and logistical support divisions, sections, and teams are assigned to combat units.³

³ ROC Ministry of Education, *Education in the Republic of China*, 1991.

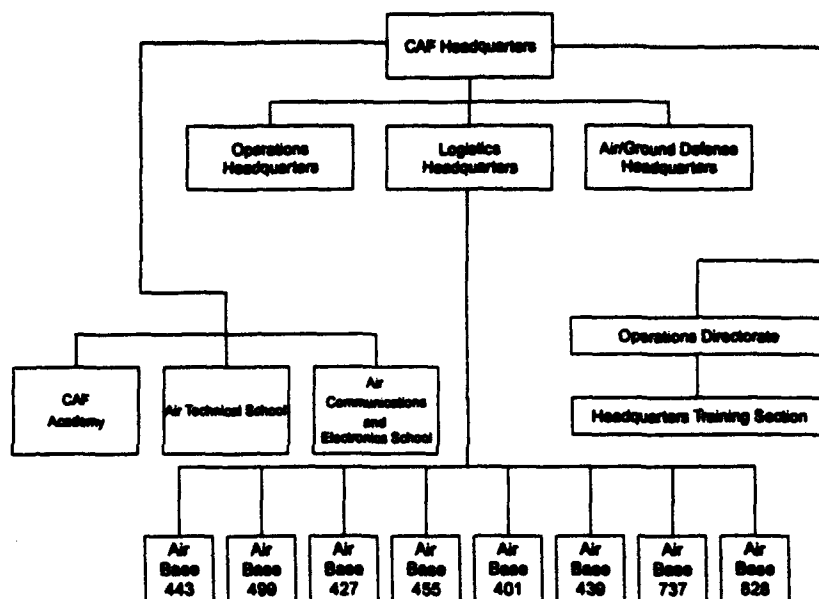


Figure 2. Organization of the Chinese Air Force.

Under the command of the Air Force General Headquarters are an Air Force Operations Command, Air Force Logistics Command, The Air Defense Artillery Command, and various tactical forces. The Air Force is further divided into Wings, Groups, Squadrons, and Flights.⁴

The Air Force General Headquarters manages all Air Force affairs and is responsible for developing and maintaining the Air Force's combat capability and commanding and supervising all Air Force units. It has a Secretariat for the Commander in Chief, a Political Warfare Department, an Officer of the Inspector General,

⁴ Government Information Office, *The Republic of China Yearbook*, Taipei, 1993.

Directorates of Personnel, Intelligence, Operations, Logistics, Planning, and Audit, as well as Divisions of Communications and Electronics, Surgery, Military Law, General Affairs, and Welfare Services. One of the organizations reporting to the operations directorate is the Headquarters Training Section.

C. ORGANIZATION

1. CAF Headquarters

Officer training in the CAF comes under the direct control of CAF Headquarters. There are nine officers at CAF headquarters who supervise training for the entire Air Force. Figure 3 shows the organization of this central unit, by area of responsibility and rank.

Each of the nine officers at CAF Headquarters specializes in one of the nine general career areas available to officers in the Air Force. The communications and training areas are each supervised by a Captain. There are four Majors to deal with issues in the operations, logistics, planning, and political training divisions. Two Lt. Colonels are tasked with the human resources and information management areas. The Colonel in charge of the Headquarters Training Section is tasked with issues in the administrative management area. When one of the officers is transferred, retired, or otherwise relocated from the training section, an officer with the same career specialty and rank must be appointed to replace him. In addition to each officer's area of expertise, problems and

inquiries relating to all occupational areas are dealt with by each of the officers in the headquarters section.

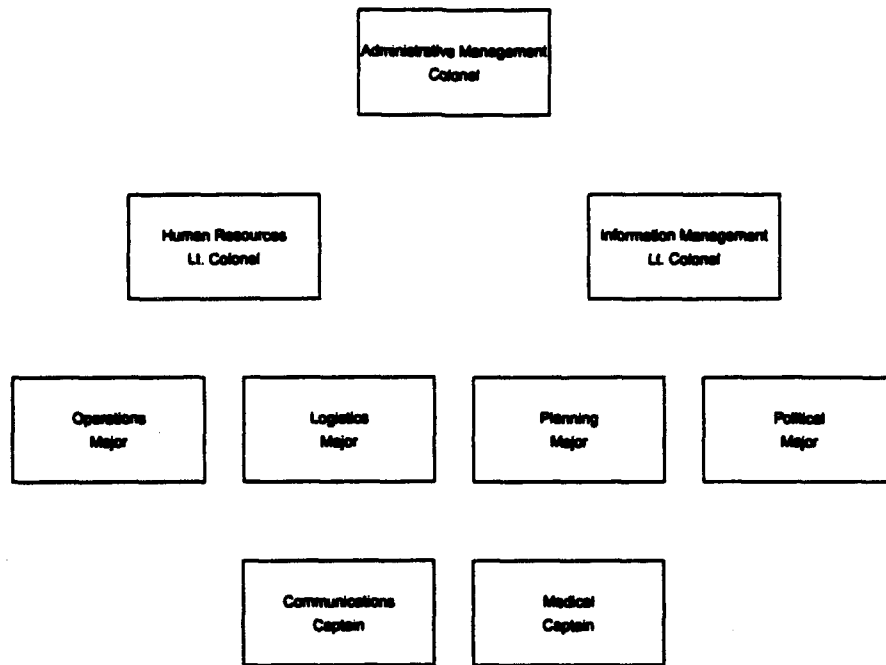


Figure 3. CAF Headquarters Training Section.

2. Sections, Headquarters, and Bases

Each section, major command, and base in the CAF has two officers tasked with training responsibilities. These officers (usually one major and one captain) are not exclusively tasked with training, but rather work within a human resources section of the chain of command, having varied responsibilities at different times and in different

circumstances (i.e., in-processing and out-processing of personnel, administrative matters, etc.). Due to workloads and time limitations, these training officers are only involved in actually training at the administrative level (tracking progress, scheduling tests, etc.).

3. Training Areas

Table I shows the nine major career fields and the occupational specialties that fall within each one. The Administrative Management area includes occupations such as General Administration, Typist, Filing Clerk, Security Management, Financial Management, Accounting Management, and Audit Management. The Human Resources area of occupation includes career fields in General Personnel Management, Field Grade Personnel Management, Installation Grade Personnel Management, Non-Commissioned Officer Management, Enlisted Personnel Management, Civilian Employee Management, Personnel Evaluation, and Flight Personnel Management. Career fields in the Operations area include Fighter Pilot, Cargo Pilot, Navigator, Flight Engineer, Line Maintenance Mechanic, Air Mechanic, Rigger, Air Traffic Control, Meteorology, Air Base Defense, and Flight Security. The Logistics area of career fields includes specialties in Supply (Aircraft), Payroll Management, Allotments, Pensions, Supply (Equipment), Subsistence Allowances, Supply (Food), and Military Insurance. The Information Management area of occupational specialties includes careers in National Information, Ground (Topographical) Information, Enemy Information, Flight Information, Meteorology Information, Legal Information, and Special Information.

TABLE I. OCCUPATIONAL SPECIALTIES IN THE CHINESE AIR FORCE, BY MAJOR AREA

Administrative Management	Human Resources	Operations	Logistics	Information Management
General Administrative	General Management	Fighter Pilot	Supply Of Aircraft	National Information
Typist	Field Grade Officer Mgmt.	Cargo Pilot	Payroll Management	Ground (Topographical) Information
Security Management	Installation Grade Officer Mgmt.	Navigator	Allotments	Enemy Information
Financial Management	Non-Commissioned Officers Mgmt.	Flight Engineer	Pensions	Flight Information
Accounting Management	Enlisted Personnel Management	Line Maintenance Mechanic	Supply & Equipment	Meteorology Information
Audit Management	Civilian Employee Management	Air Mechanic	Subsistence	Legal Information
	Personnel Evaluation	Rigger	Supply-Food	Special Information
	Flight Personnel Management	Air Traffic Control	Military Insurance	
		Meteorology		
		Air Base Defense		
		Air Defense		
		Flight Security		
Planning	Political	Communications	Medical	
Organization	General Political Work	Computer Hardware Maint.	General Medicine	
Aircraft	Detection & Supervision	Computer Software Maint.	Innoculations	
Weapons	Information Issue	Telephone Maintenance	Pharmaceuticals	
Air Strategy	Political Education	Radar Systems	Emergency Medicine	
Maneuvers	Entertainment & Welfare	Systems Design	Primary Care	
		Telegraph Systems		

The Planning area includes the career fields of Organization, Aircraft, Weapons, Air Strategy, and Maneuvers. In the Political area of occupational specialties, there are career fields in General Political Work, Detection and Supervision, Information Issue, Political Education, and Entertainment and Welfare. The Communications area includes the career fields of Computer Hardware Maintenance, Computer Software Maintenance, Telephone Maintenance, Radar Systems, Systems Design, and Telegram Systems. The Medical area includes career fields in General Medicine, Innoculations, Pharmaceuticals, Emergency Medicine, and Primary Care.⁵

D. COMMISSIONING PROCEDURES

Individuals are commissioned as officers in the CAF in one of three ways. Some attend the Air Academy, and are commissioned upon graduation. Other officers have attended specialty schools (such as the CAF Air Technical School or Air Communications and Electronics School) to seek commissions. Still other officers come to the CAF upon the completion of a private college education. In this case, the officers have passed qualifying tests while still in school, and the results of these tests identify them as officer candidates. They receive commissions upon graduation.

Considering the ROC military as a whole, 15% of the officers commissioned each year are graduates of the service academies. Another 45% of newly commissioned officers are graduates of specialty training schools, and approximately 40% are

⁵ Gregor, A., and Hsia Chang, M., *The Military Defense of the Republic of Taiwan*, Taipei, 1981.

individuals who have been identified as officer candidates while attending private institutions.⁶

CAF Academy graduates complete a four year course of study; one of those years is spent in flight training. Officers who do not successfully complete flight training are transferred to another occupational area. Whether the officer is a graduate of the academy or one of the two colleges, they must complete an additional three months of study known as primary training.

E. TRAINING PROCEDURES

1. Overview

Education is highly valued throughout the ROC military. Almost 28% of all active duty personnel have a junior college education or better. Another 49% are high school or vocational high school graduates. In addition, specialty training is provided by the military to over 83% of all enlisted individuals.⁷

In some ways, the movement of the CAF toward a Total Quality Leadership/Total Quality Management environment has complicated, rather than enhanced, its training operations. As an example, the CAF recently initiated a policy of multi-sourcing for its military equipment. Previously, the ROC had depended on a single source for any given item of military equipment (usually the US). In such a situation, especially when the policy is maintained over a long period of time, training becomes

⁶ Department of Conscription, *The 1991 Annual Report on Conscription*, Nation, 1992.

⁷ Ministry of National Defense, *The National Defense Report*, Taipei, 1992.

simplified. This occurs for a variety of reasons, among them: the single provider of equipment is more willing to provide increased levels of training support to protect its investment; even as the systems evolve, there is a consistency of approach to design that makes the evolving training procedures complimentary; a single equipment source over time reduces the need to retrain personnel at higher levels (the basic training requirements for the system are consistent, and only lower level personnel require retraining to acquire newly changed details, while higher level personnel can be effective through maintaining a perspective on the bigger picture).

The decision of the CAF to change to a multi-source approach to procurement, while consistent with the principles of TQL/TQM, emphasizes the need for the CAF to focus attention on further developing another aspect of TQL/TQM philosophy: training.

In the case of CAF officers, the current approach to training is taken in three steps: Primary, Advanced, and Quality. Under the current system, each officer begins his career with a period of training at the Primary level. While meeting duty obligations, the officer is expected to pursue additional training at the two higher levels.

2. Primary Training

Primary training takes place at one of the general occupation training centers, which correspond to the nine major areas of occupational specialties. These training centers are divided between the academy and the two colleges. Administrative Management, Human Resources, Planning, Political, and Medical curricula are all located at the CAF Academy. The CAF Mechanical College is the site of Logistical and

Operational training, and the CAF Communications College is the location for instruction in Information Management and Communications (see Figure 4).

After completing three months of primary training, the officer is sent to a unit for duty. It should be noted that these three months of primary training take place *after* the officer has completed his course of study at the school. In other words, an officer who has completed a course of study at one of the Administrative Management schools will then take an additional three month primary training course at the school.

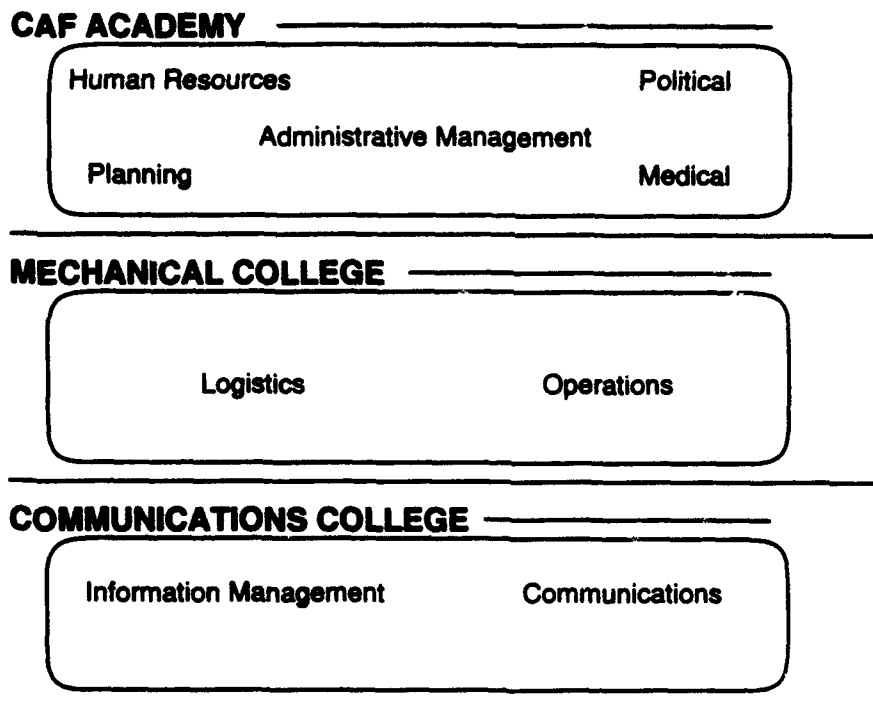


Figure 4. Location of Occupational Training Centers.

3. Advanced Training

Advanced training begins with the arrival of the officer at his duty station. Over the course of three months, the officer has the opportunity to become familiarized with the equipment and procedures involved in his particular specialty. In the case of technical specialties, the emphasis is on correct operation and maintenance of equipment. While there is a framework for organized advanced training, in practice this becomes "on-the-job" training.

4. Quality Training

Quality training also occurs within the officer's unit, and focuses on the officer's ability to handle unexpected problems. An officer who has completed quality training is prepared to operate within his occupational specialty without supervision by a more qualified individual.

F. TESTING PROCEDURES

1. Primary Testing

Testing for primary skill levels is performed before the officer leaves the training center. The objective of this level of testing is to ensure that a basic level of understanding is achieved by the officer in his general area of training. It is not assumed that personnel will be functional in their respective capacities because they have achieved successful evaluations at the primary training centers. In fact, the primary level of testing

is generally considered to be unchallenging; it is rare for an officer not to pass the primary level evaluation.

2. Advanced Testing

Advanced testing is performed at the unit, and can take place anytime after the first three months of duty. The advanced level of testing demands an operational knowledge of equipment, materials, and procedures to be used by the officer in performing his specific duties. Failure in testing at the advanced level will mean that an officer must wait another three months, during which time he is to receive remedial training, to take the test again. A second failure will mean that the officer must choose another occupational specialty, and is likely to experience a delay in promotion (usually one year).⁸

Advanced testing is performed by officers dispatched from CAF Headquarters. The nine officers at the headquarters take turns traveling to every base, section, and headquarters unit to administer these tests. The exams are stored at CAF headquarters and hand carried to testing locations by the designated testing officer(s). Each exam has fifty questions pertaining to the specific occupational specialty, and all of the exams for each specialty are alike.

3. Quality Testing

Successfully completing quality testing is the indicator that an officer is capable of functioning at an expert level within his position. Quality testing returns a failure rate approaching 30%.⁹

⁸ Chinese Air Force, *Air Force Training: 1992*, Taipei, June, 1992.

Quality testing is administered by an officer's operational superior. The officer's abilities are measured in the performance of his specific duties. The immediate supervisor will make an evaluation of the officer's skills, and he will either be awarded with quality level ratings or given another chance to take the test after three months. As in the case of advanced training, failure to attain quality ratings a second time will mean that he must choose another occupational specialty.

G. LIMITATIONS

1. Time

Because of the great demand for testing services, some officers may be at their unit -- and performing the specific job to which they are assigned -- for six months before having the opportunity to be tested.

The evaluation system is not a timely indicator of the level of ability of CAF officers due to the delay incurred by having to wait for a scheduled visit by a testing officer from the Headquarters Training Section. There is an additional delay incurred by waiting for a sufficient number of officers in a given career field to reach the point where they require testing so that sending someone from the Headquarters Training Section to the test site is warranted.

Another aspect of the timing issue is that the tests themselves must be manually scored. Only when a test is scored can the information from that test be passed on to the officer's personnel file. The data that comes from a series of evaluations in a given period

⁹ ibid.

takes some time to be collated and analyzed to provide an indication of the success of training.

2. Cost

The current method of training and testing is very expensive. The nine officers of the CAF headquarters who are tasked with testing responsibilities must travel to every CAF operated facility to administer tests. There are also the costs of testing materials to be considered. The current strategy is to maintain massive inventories of written testing materials for use in officer evaluations. Additionally, the training centers currently consume vast amounts of resources in the form of staff time, supplies and training aids, and other budget items, while providing only primary (minimal) training.

3. Quality

Another consequence of the current method of training and testing is that it fails to achieve a level of confidence with regard to the measurement of the officer's abilities. Because the tests utilize the same fifty questions for each specialty, they sometimes more accurately measure the officer's ability to pass the test rather than his ability to perform in his function. Knowledge of the test questions relieves the officer of the necessity to learn correctly all of the information required to perform in his position. This is aggravated by the fact that the test questions are always the same; someone failing the first exam will take an identical test the second time.

4. Flexibility

As mentioned above, the tests for each occupational specialty are identical. Inventories of tests are maintained. This means that any changes which are made in the responsibilities of an officer's position must slowly make their way into the testing process for that occupation. Rapid changes in technology and procedure cannot be reflected in a timely fashion on tests designed to measure the officer's ability.

5. Manpower

Another drawback to the current system is its inefficient use of manpower. First, the evaluation system requires that CAF headquarters personnel charged with training and evaluation spend their time traveling from place to place. Second, the system that is in place requires all of the officers who are to be tested during a particular visit of headquarters personnel to assemble at one time and in one place for the exam.

Another negative impact of the current system from a manpower perspective involves the training procedures at the advanced and quality levels. While the primary training received at training centers is the ultimate objective of the centers themselves, the advanced and quality levels of training are conducted at the operational unit. Even though there are training officers at all sections, headquarters, and bases, their time is occupied with the administration of training and evaluation, which means that the actual training is left to unit personnel. As a result, the unit must choose between mission requirements and training requirements when scheduling activity and resources, often to the detriment of both training and operational ability.

Yet another manpower problem can be found in the duplication of activity. For instance, there is a headquarters officer who is tasked with medical training responsibilities at the same time that the staff of the medical curriculum at the Academy is engaged in training activity, yet there is little or no cooperation between the two, which often results in contradictory information being circulated.

H. THE CAF COMPUTER NETWORK

The CAF currently maintains a very large computer network. The complete network is divided into four primary areas of operations. The first of these is the network hub, which is located in Taipei. The three other areas of network operations include the Headquarters system, and the systems installed at each Section, School, and Base.

Figure 5 depicts the CAF Computer Systems Network architecture, which links each type of system together at the Air Force-wide level. The specific hardware installed in each of these systems which comprise the overall network can be noted in each of the figures. The Air Force Headquarters system pictured in Figure 6 consists of a gateway to the military-wide network, a central processing network, a bridge to local area networks (LANs), and a server gateway for connections via modem.

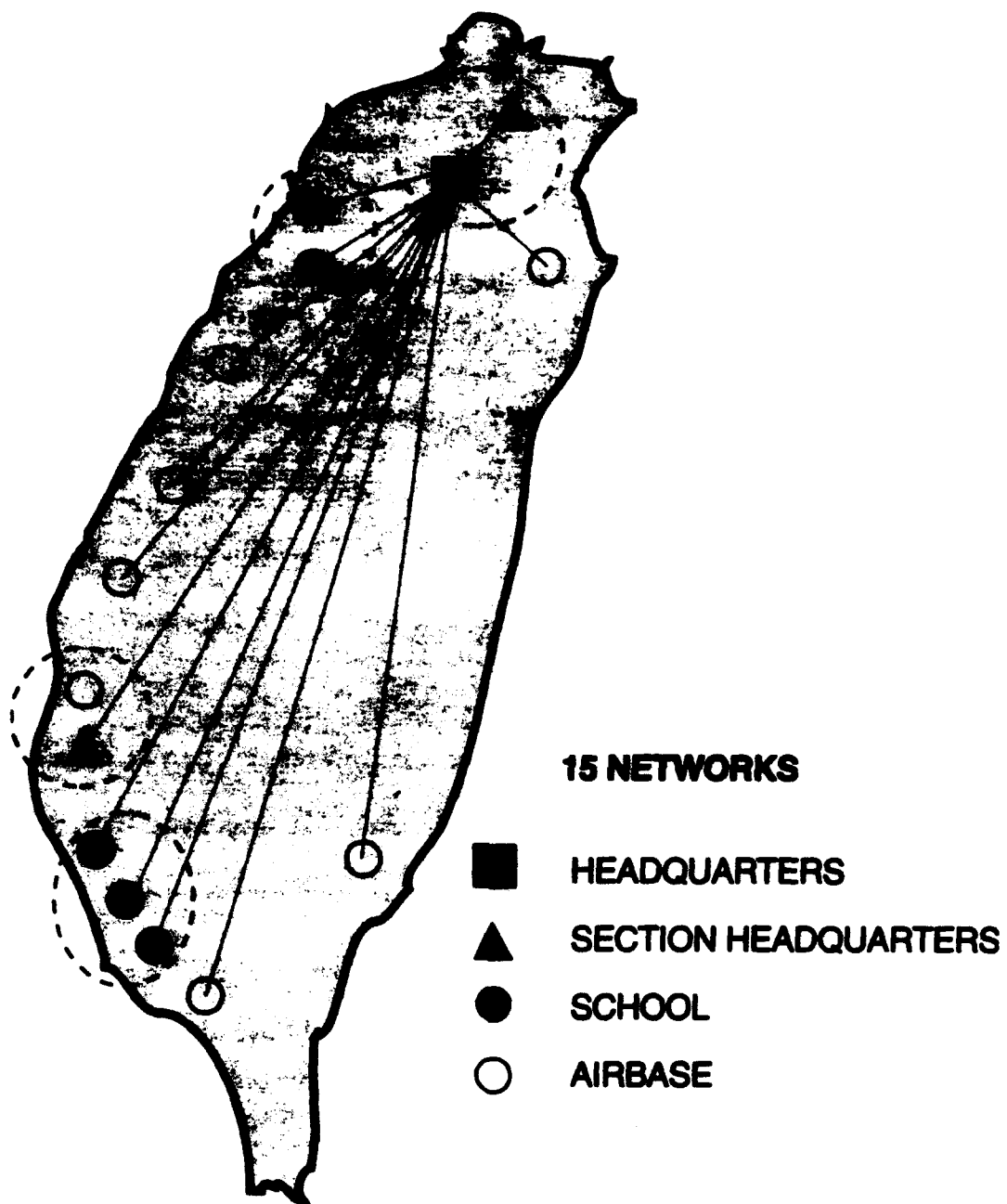


Figure 5. CAF Computer System Geographical Architecture

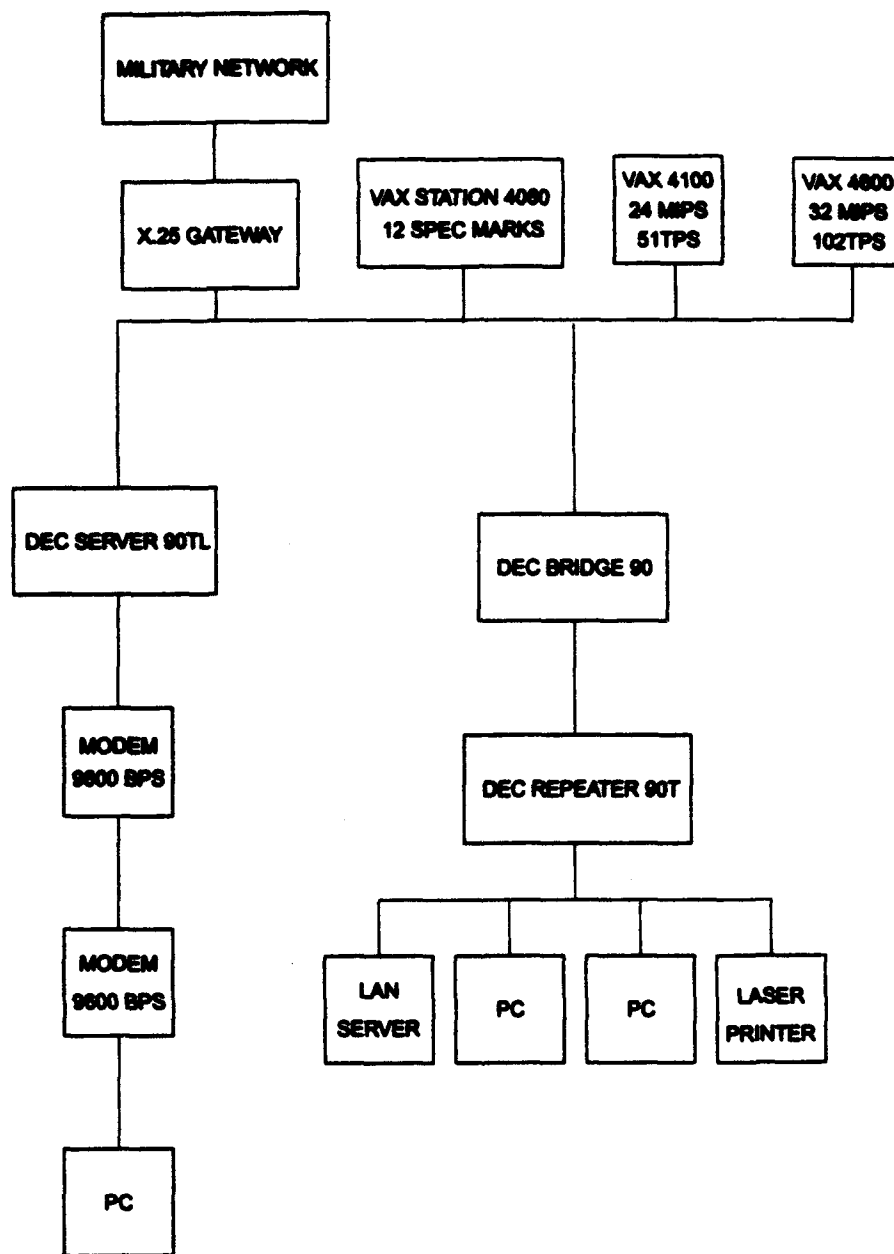


Figure 6. CAF Headquarters Computer Network

The Section Headquarters systems are composed of a gateway to the military-wide network, a central processing network, bridges to local area networks, routers that allow connections via leased line to specialized local area networks, and a server gateway for connections via modem. In this example (Figure 7), there are three examples of local area networks connected via leased line: a meteorology computer, a war game simulation computer, and a LAN configured for a distant office environment. The Base or Technical School systems are typically configured as shown in Figure 8. Once again, the system architecture is comprised of a gateway to the military-wide network, a central processing network, bridges to local area networks, routers that allow connections via leased line to specialized local area networks, and a server gateway for connections via modem. Air Force wide, there is one system of the type described in Figure 6, three systems of the type described in Figure 7, and eleven systems of the type described in Figure 8.

The CAF computer network is currently used for operational communications, and financial and manpower management. Additionally, specialized systems, such as the processors used in war gaming and simulations, are connected to the network.

Access to the computer network can be achieved in several ways. Users may dial in from their own personal computers by means of a modem (up to 9600 bps). There is access to the system through "dumb terminals." Also, each office within every Base, School, and Section has a personal computer through which the system can be accessed.

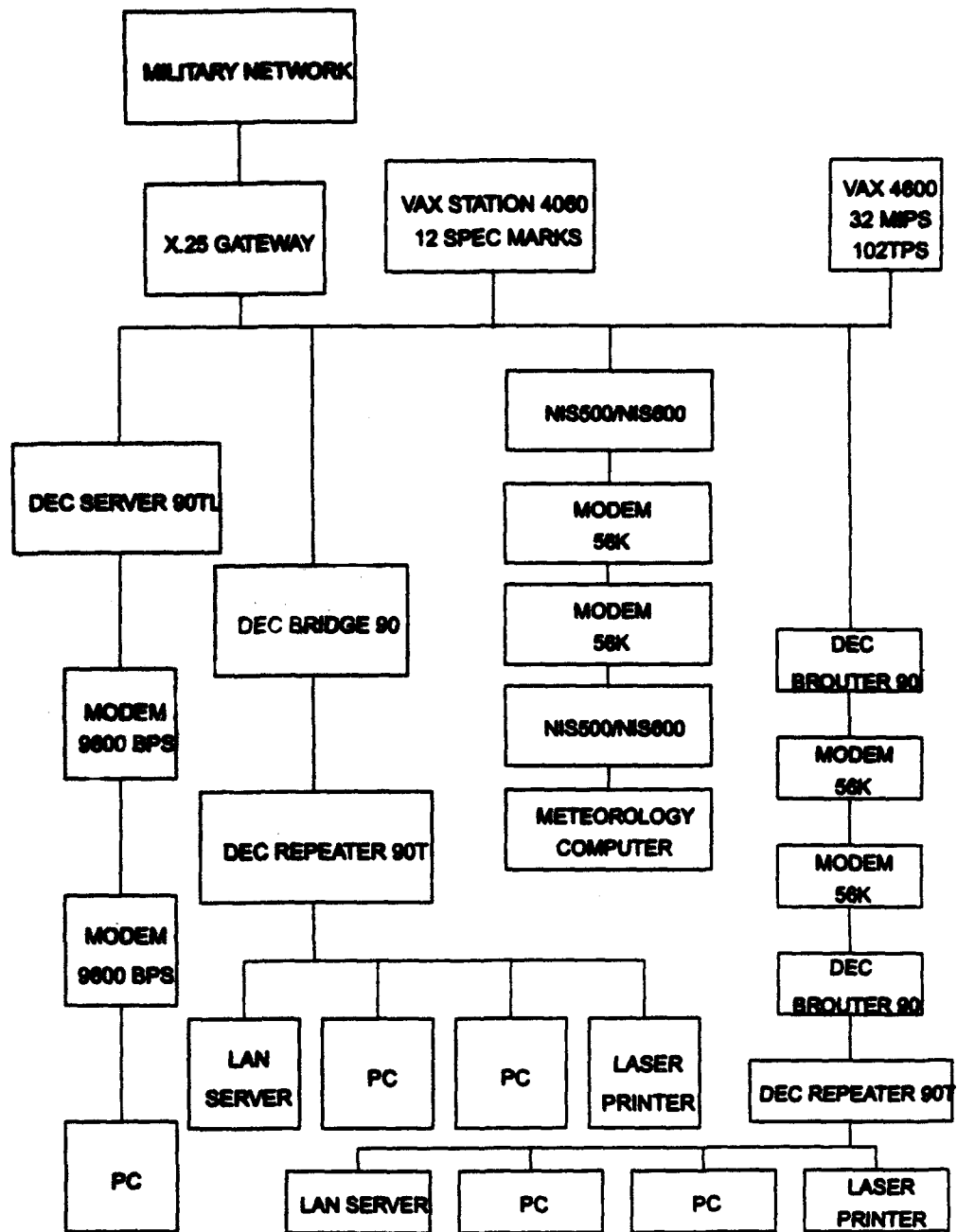


Figure 8. CAF Base or School Computer System Network

III. ADVANCED TECHNOLOGIES IN EDUCATION AND TRAINING

A. OVERVIEW

Distance education generally implies several factors about a learning situation¹⁰:

- ♦ The existence of a teacher/instructor, one or more students, and a contract stipulating learning of subject matter between the two.
- ♦ An environment that includes physical separation of teacher and student.
- ♦ Physical separation of the students and the institution that is sponsoring the learning situation.
- ♦ Two-way communication between the teacher and the students involved.
- ♦ The specific design of any materials used to be suited to distance study.

Distance learning has traditionally been an option of necessity, brought about by various factors that have inhibited development of a more traditional learning environment (which can be termed a "face-to-face" environment). Geographic separation, for example, has been a historical motivation to move toward some form of alternative education. When individuals are separated by great distances, it makes it impractical to bring them together for a course of study. One alternative has been to establish many facilities to serve many students in a variety of locations, an alternative that is becoming increasingly cost-prohibitive. Another alternative has been for students

¹⁰ Wells, Rosalie A., *Computer-Mediated Communications for Distance Education and Training: Literature Review and International Resources*, Boise State University, 1990.

and teachers to communicate with one another through the mail, exchanging coursework assignments, criticism and commentary, and even examinations in this manner.

The historical view of distance education has, however, lead to many misconceptions. The view that it is predominantly an alternative to be explored by rural students does not withstand the results of statistical examination, which point to the contrary.¹¹ In fact, there is every indication that many students who are ideally situated for participation in a residence learning environment will choose to enter a distance education curriculum.¹² It should be remembered, however, that these results may have more to do with considerations of time than location. It may be that someone who *could* participate in a local residence institution may not have sufficient time available for the purpose, and so ends up in a distance curriculum.

Undoubtedly, the single largest cause of the recent proliferation of academic offerings in distance education is the rapid advance of technological innovation. In addition to the creation of new technologies, various industries (among them software and hardware manufacturers, telecommunications and entertainment companies) have played a role in making distance education a more attractive and efficient alternative to traditional methods of teaching.

To the student, distance education offers an opportunity to pursue educational goals without being physically located near an institution. Over the years, a profile of the

¹¹ Borg, W.R., and Gall, M.D., *Educational Research*, 4th Ed., Longman, New York, 1983.

¹² DiSilvestro, F.R., and Makowitz, H.J., *Contracts and Completion Rates in Correspondence Study*, Journal of Educational Research, 1982.

typical distance learner has been developed. This profile includes students from rural areas, as well as students whose other activities (most commonly work) preclude the "normal" pattern of education.¹³

In addition, the evolution of distance education has produced the concept that course curricula and educational materials be specifically designed for a distance education environment.¹⁴ This is most probably a result of the time requirements involved in communicating by mail, and the limitations of a situation where there is no direct contact between teacher and student (other than by mail).

B. THE EVOLUTION OF DISTANCE EDUCATION

Thus far, there have been two primary phases in the development of distance education: correspondence and broadcast. Correspondence courses were originally developed in America in the 1870's. By 1882, the University of Chicago had established its home study division, and the National University Extension Association established a Correspondence Study Division in 1915. At this point the broadcast phase of distance education began to develop. By 1923 the number of radio stations in the US that were owned by educational institutions was over ten percent of the total, and these institutions were using their radio stations to deliver educational programming.¹⁵

¹³ Borg, W.R., and Gall, M.D., *Educational Research*, 4th Ed., Longman, New York, 1983

¹⁴ Anderson, R.H., *Selecting and Developing Media for Instruction*, Von Nostrand, New York, 1976.

¹⁵ Corporation for Public Broadcasting, *Telecourses: Reflections '80 Executive Summary*, Washington D.C., Corporation for Public Broadcasting, 1980.

The Federal Communications Commission was established in 1934, and the Association of College and University Broadcasting Stations was organized as a response designed to give educational institutions a voice through which to appeal and maintain frequencies for educational broadcast. The establishment of the Public Broadcasting System was a positive response to this activity, as it mandated educational use of public broadcasting stations.¹⁶

The first educational program designed for television broadcast was created by the City College of Chicago in 1951.¹⁷ This was a program that offered televised courses for credit, and was used extensively by returning veterans of World War II and the Korean War, enabling disabled veterans to obtain instruction that would otherwise have been unavailable. The use of telecourses was experimented with throughout the 1950's and 1960s, but interest in the US began to dwindle in the 1960's as the result of the failure of a number of such experiments.¹⁸ Across the Atlantic Ocean, however, the British Open University was opened in 1969. The Open University places specific emphasis on instruction by television and has been a great success, continuing to enroll approximately 40,000 students per year.¹⁹ The success of this program was responsible for a resurgence in interest in telecourses in the US in the 1970's.

¹⁶ Carnegie Commission, *Public Trust: The Report of the Carnegie Commission on Public Broadcasting*, New York, 1979.

¹⁷ Corporation for Public Broadcasting, *Telecourses: Reflections '80 Executive Summary*, Washington D.C., Corporation for Public Broadcasting, 1980.

¹⁸ *ibid.*

¹⁹ Bates, A., *The Open University: Television, Learning and Distance Education*, Open University, 1987.

With the increase in costs associated with traditional education, as well as the increasing educational effort required to maintain economic competitiveness, the role of distance education is seen as growing, in light of technological achievements that promise to enhance the ability of teachers to teach and students to learn over distances. The following section describes the various media through which distance learning is currently (or potentially) exploited, and the factors that motivate each as a choice of the distance education designer.

C. COMMUNICATIONS MEDIA

1. Written Correspondence

Distance education accomplished through written correspondence is categorized as taking place through a "paper-based" medium. Paper-based course design is attractive to the curriculum designer when the following factors are at work:²⁰

- Large numbers of students will enroll
- Wide geographical dispersion of learning materials is needed
- Written materials are needed to be used as a reference later
- Course content contains a lot of background information
- Self-study is appropriate
- Student load is sporadic; unscheduled access to materials is needed
- Group interaction is not required

²⁰ Cherry, A., and Renckly, T., et. al., *Distance Learning: Curriculum Analysis and Media Selection*, Media Selection Guide, Air University, 1993.

- Course content is relatively stable
- Course content addresses lower levels of cognitive learning
- Low realism, low feedback required

The use of the paper-based curriculum assumes that no new equipment is available to the teacher or the student, that there is adequate lead time for development of course materials, that there is an available means for distribution (in most cases a budget for postage), and that testing procedures are decentralized.

The paper-based medium for distance education is depicted in Figure 9.

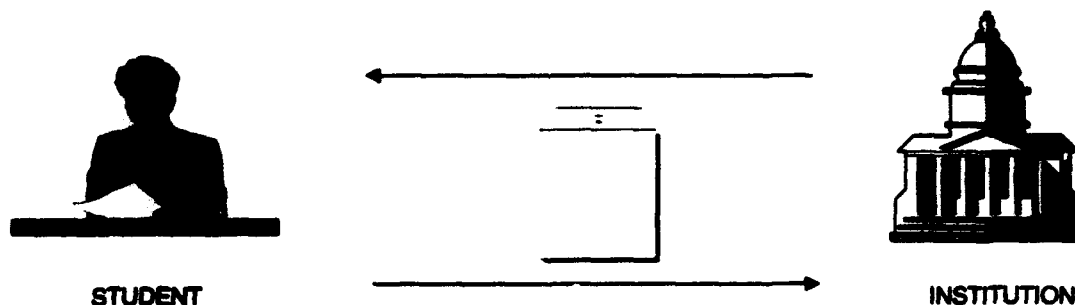


Figure 9. The Paper-Based Medium of Distance Education.

2. The Non-Resident Seminar

The non-resident seminar exists somewhere between distance education and the more traditional classroom approach, but is still categorized as being a part of the world of distance education. This medium is the most basic attempt to merge the paper-based curriculum with traditional education, in that it provides for the establishment of the traditional instructional environment as and when the benefits of that environment are required. The curriculum designer will look to the non-resident seminar when:²¹

- ♦ Real-time group/peer interaction is required
- ♦ Delayed interaction with faculty is sufficient
- ♦ Course content addresses higher levels of cognitive learning
- ♦ Course content addresses some affective or psychomotor skills
- ♦ Some students cannot attend during normal hours; flexible class times are needed

The assumptions at work in the non-resident seminar are that students are able to attend the seminar at the seminar location, no new equipment is available to the instructor or the student, that administration functions are performed on-site, that students facilitate the course structure, that facilitator manuals are available to the student, and that a mix of instructional aids can be added to the course to enhance its educational value.

Figure 10 is an illustration of the non-resident seminar approach to providing a medium for distance education.

²¹ **ibid.**

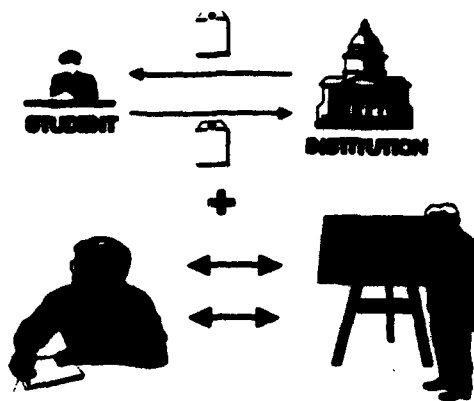


Figure 10. The Non-Resident Seminar Medium of Distance Education.

3. Audiotape

A course can be delivered via audio, much like the early distance education programs of the City College of Chicago, with the exception that audiotape has replaced audio broadcast as the medium of choice. In an audiotape curriculum, students receive aural instruction on magnetic cassette tapes, which can be played in any conventional cassette tape machine. The curriculum designer is interested in audiotape media when:²²

- Visual representation is not needed
- Course content is subject to frequent revision and update
- Course content deals with lower levels of cognitive learning
- Course is lecture-based
- Students are widely dispersed
- Self-study is appropriate

²² *ibid.*

The assumptions operating in the audiotape curriculum are that no new equipment is available to the teacher or the student, and that there is a means for distribution of audio cassettes.

The traffic pattern of an audiotape medium of communications for distance education is shown in Figure 11.

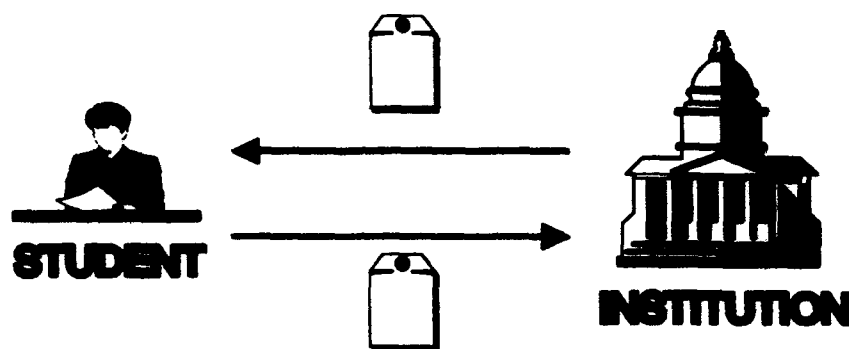


Figure 11. The Audiotape Medium of Distance Education.

4. Videotape

Videotape is most similar to the "telecourse" routes of modern distance learning. The advantage to videotape presentation is that no synchronicity is required between a broadcaster and all of the individuals participating in the curriculum as students. Multiple copies can be made and dispersed for use by the student at his or her own discretion. The curriculum designer considers videotape as a medium when:²³

- ♦ Audio and visual presentations are important for clarity
- ♦ Realism is needed

²³ ibid.

- ♦ Real-time feedback and interaction with faculty are not needed
- ♦ Group or independent study is appropriate
- ♦ Content is stable; requires few revisions
- ♦ Course content deals with complex descriptions or procedures
- ♦ Return demonstration of student performance and observation by faculty are not required

Figure 12 depicts the activity of the videotape medium of distance education.

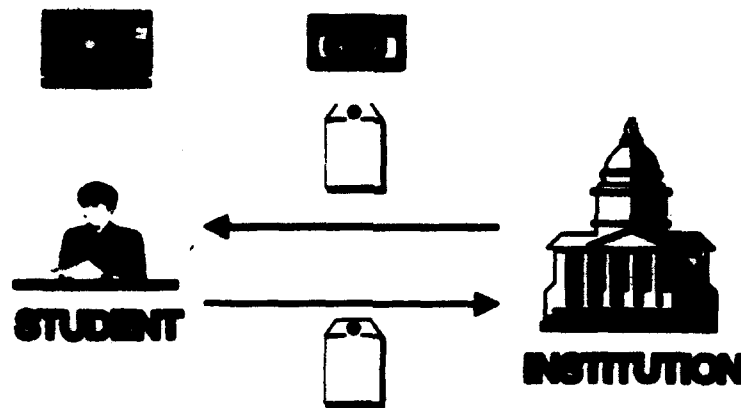


Figure 12. The Videotape Medium of Distance Education.

The assumptions made by the designer of a videotape curriculum are that TV production and editing facilities are available and that there is an adequate means for distribution. A variation on the videotape medium is to broadcast the content of the video

material. This medium is then easily recognizable as the broadcast correspondence course, such as those currently given in Taiwan, the US, and other areas of the world.

5. Interactive Courseware (ICW)

Interactive courseware refers to the new domain of computer-assisted learning.

The curriculum designer will favor ICW when:²⁴

- ♦ Mastery of performance is required
- ♦ Large numbers of students will enroll
- ♦ Students are widely dispersed
- ♦ Individualized learning is appropriate
- ♦ There is a sporadic student load; unscheduled entry and exit needed
- ♦ Course content contains some affective and psychomotor skills
- ♦ Realism and simulation are required
- ♦ Diagnostics and remediation required
- ♦ Immediate response-specific feedback required
- ♦ No group interaction needed
- ♦ Course content is relatively stable (no more than one major revision per year)

In promoting ICW as the curricular medium, the designer assumes that learners have ready access to needed equipment, that adequate development software exists, that there is sufficient manpower (with needed expertise) and time for development, that the curriculum can incorporate static graphic displays, animated graphics, motion sequences, still frame sequences, photographs, and audio, and that there is adequate means for

²⁴ ibid.

distribution. Figure 13 depicts communications in an ICW-mediated education or training program.

ICW can be explored as an education or training medium in one of two ways. As shown in the figure, ICW involves the student running ICW software on a PC. An alternative is to base all of the interactive software on a mainframe. In this kind of arrangement, the student would access the interactive courseware by dialing into the mainframe from a modem-equipped PC, and the distribution of software to the student would be limited to communications programming to enable the connection.

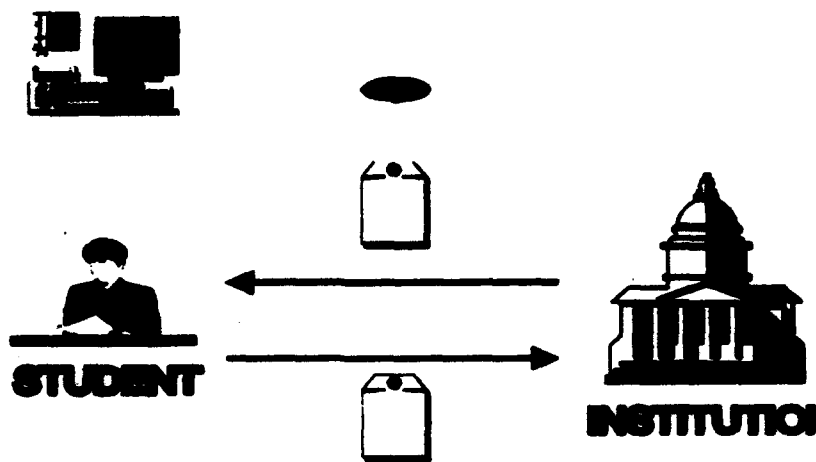


Figure 13. The Interactive Courseware Medium of Distance Education.

6. Audiographics

Audiographics is another computer-mediated medium in distance education. This arrangement involves two-way audio communications between teacher and student (or group of students) in addition to two-way computer data transmission. The computer connection allows for the transmission of text and graphics, while the audio link allows for real-time feedback. Typically, this application has involved a single large display and a single audio line in a remote classroom setting with a large number of students.

Audiographic media are chosen by curriculum designers who are confronted with the following demands:²⁵

- ♦ Real-time audiographic interaction with instructor is required**
- ♦ Real-time audiographic group/peer interaction is required**
- ♦ Course content has no psychomotor objectives**
- ♦ Course content addresses various levels of cognitive learning**
- ♦ Course content is unstable, requiring frequent updates**
- ♦ Course is relatively short in length**
- ♦ Course is lecture-based**
- ♦ Large student throughput is expected**
- ♦ Scheduled entry and exit is acceptable (synchronous communications)**
- ♦ Simulation of course materials/data with the computer is possible**
- ♦ Large amounts of data and graphics are to pass back and forth between instructor and student**

²⁵ **ibid.**

The curriculum designer, in choosing the audiographic format, assumes that instructor training is available, that it is possible to procure new equipment for the teacher and the remote class location, that there will be on-site administration of courses and an on-site facilitator, and that subject matter experts to facilitate classes at remote sites may be needed.

It must be noted that the audiographics medium, as depicted in Figure 14, requires synchronous communications between the students and instructor. In other words, wherever the students are located, and wherever the instructor(s) are located, they will all have to be in those locations at the same time to participate in the program.

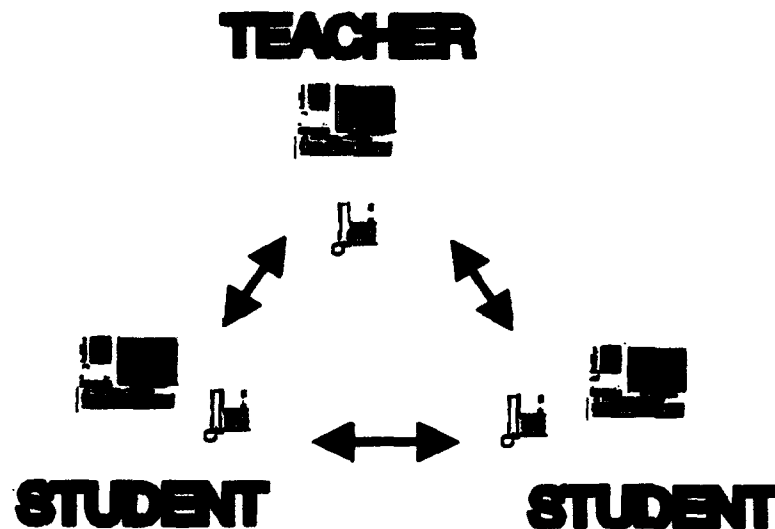


Figure 14. The Audiographics Medium of Distance Education.

7. Teleseminar

In the teleseminar, students and teachers interact one-way via video (teacher to student) and via two-way audio, a telephone link. This medium is currently well known for its use with large audiences. Typically, the teacher gives lectures in front of students and the necessary equipment is available for simultaneous video transmission to remote students. There is also two-way audio communication between teacher and student.

Teleseminar is favored by the curriculum designer when:²⁶

- ♦ Real-time interaction with instructor is required
- ♦ Real-time group/peer interaction is required
- ♦ Course content has no psychomotor objectives
- ♦ Course content addresses various levels of cognitive learning
- ♦ Course content is unstable and requires frequent updates
- ♦ Course, or module, is relatively short in length (max 20 days)
- ♦ Course is lecture-based
- ♦ Large student throughput is expected
- ♦ Scheduled entry and exit are acceptable parameters

The designer will assume that the situation allows for teacher/instructor training, that it is possible to procure new equipment for teacher and student locations, that there will be on-site administration of courses and an on-site facilitator, that video production capability and video classrooms are needed, and that subject matter experts may be required to be present at remote classroom sites. *The teleseminar is usually characterized*

²⁶ **ibid.**

by a short course length. It is currently utilized in the business sector to distribute timely information on specific topics. Figure 15 depicts communications in the teleseminar medium.

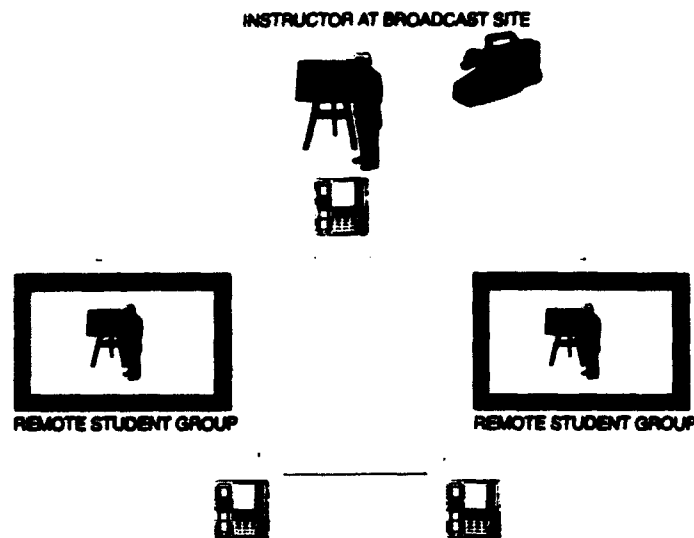


Figure 15. The Teleseminar Medium of Distance Education.

8. Teleconferencing

Teleconferencing involves two-way video, two-way audio, real-time distance education. Essentially this medium, which has been widely and successfully used in the business sector, allows for an audio/video two-way link to be established between the location of the instructor and each remote site. This enables student/teacher and student/student audio and video feedback.

The curriculum designer will consider teleconferencing as a medium for distance education when:²⁷

- ♦ Real-time interaction with instructor is required
- ♦ Real-time group/peer interaction is required
- ♦ Course content has no psychomotor objectives
- ♦ Course content addresses various levels of cognitive learning
- ♦ Course content is unstable and requires frequent updates
- ♦ Course, or module, is relatively short in length
- ♦ Course is lecture-based
- ♦ Large student throughput is expected
- ♦ Scheduled entry and exit are acceptable parameters
- ♦ Some objectives address psychomotor skills
- ♦ Some demonstration/performance is required
- ♦ It is necessary for faculty to observe student processes or student interaction

The designer will assume that the situation allows for teacher/instructor training, that it is possible to procure new equipment for teacher and student locations, that there will be on-site administration of courses and a site facilitator, that two-way video classrooms are achievable, and that subject matter experts may be required to be present at remote classroom sites.

The teleconference is becoming more and more popular in the business sector. One reason for this is that teleconferencing eliminates much of the travel expense

²⁷ *ibid.*

previously associated with bringing people together to discuss issues. A consequence of this is that teleconferences typically involve more participants than would otherwise be included in such meetings and discussions, thereby improving their overall effectiveness. Communications in the teleconference medium are depicted in Figure 16.

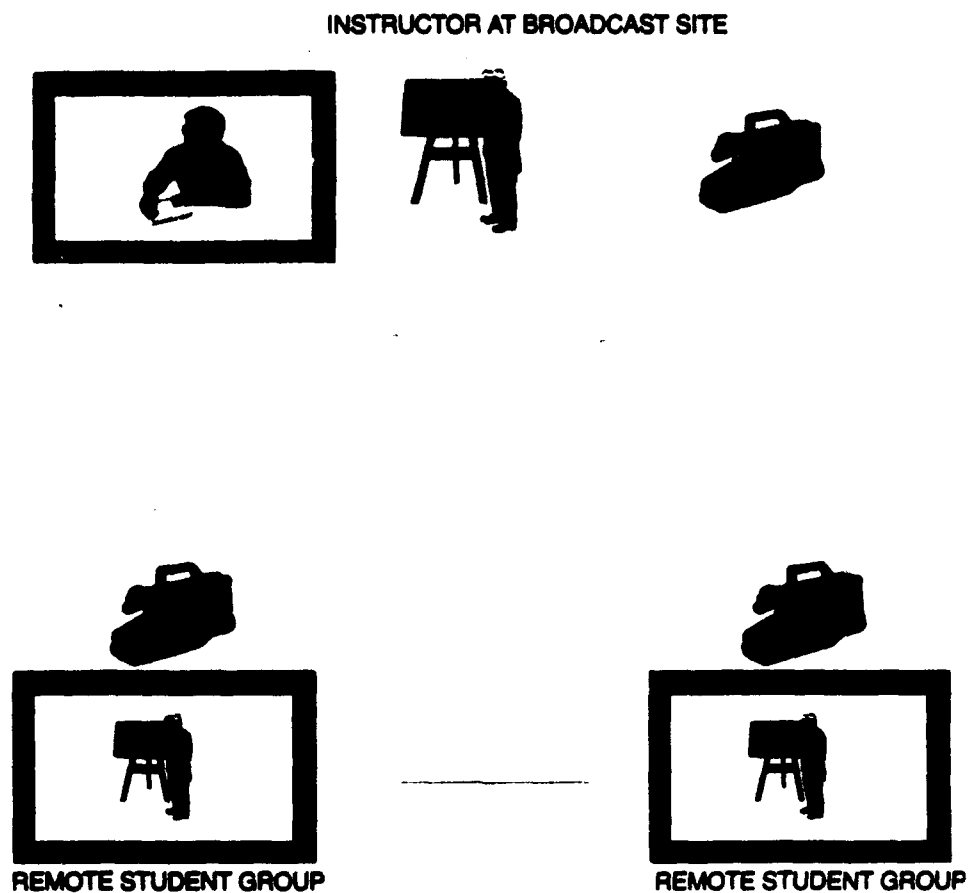


Figure 16. The Teleconference Medium of Distance Education.

9. Digital Fusion

Digital Fusion has been described as the convergence of computing, television, printing and telecommunications.²⁸ This next generation of multimedia educational medium promises the ability to create, develop, produce, transmit, and do post production work over the range of telecommunications elements (audio, text, graphics, full motion video) through a single, easy-to-use videographic console.²⁹

- ♦ The distance learning environment envisions a multi-course, "electronic university."
- ♦ Vast quantities of current information in text, graphics, and full-motion video are required
- ♦ Student access to equipment is individual, rather than remote-classroom-based
- ♦ Real-time interaction with faculty and other personnel is required
- ♦ Real-time group/peer interaction is required
- ♦ Course content has no psychomotor objectives
- ♦ Course content addresses various levels of cognitive learning
- ♦ Course content is unstable and requires frequent updates
- ♦ Course, or module, is relatively short in length
- ♦ Course is lecture-based
- ♦ Large student throughput is expected

²⁸ Arnett, N., and Greenberg, M., "Multimedia Computing", Annenberg/CPB Project, Washington, D.C., 1989.

²⁹ Brey, R., *U.S. Postsecondary Distance Learning Programs in the 1990's*, Instructional Telecommunications Consortium, Washington, D.C., 1991.

- ♦ **Scheduled entry and exit are acceptable parameters**
- ♦ **Some objectives address psychomotor skills**
- ♦ **Some demonstration/performance is required**
- ♦ **It is necessary for faculty to observe student processes or student interaction**

The designer will assume that the situation allows for teacher/instructor training, that it is possible to procure new equipment for teacher and student locations, that there will be on-site administration of courses and a site facilitator, that digital transmission of information in a variety of formats is achievable, and that the technology required is both available and affordable. The communications pattern of a digital fusion environment is depicted in Figure 17.

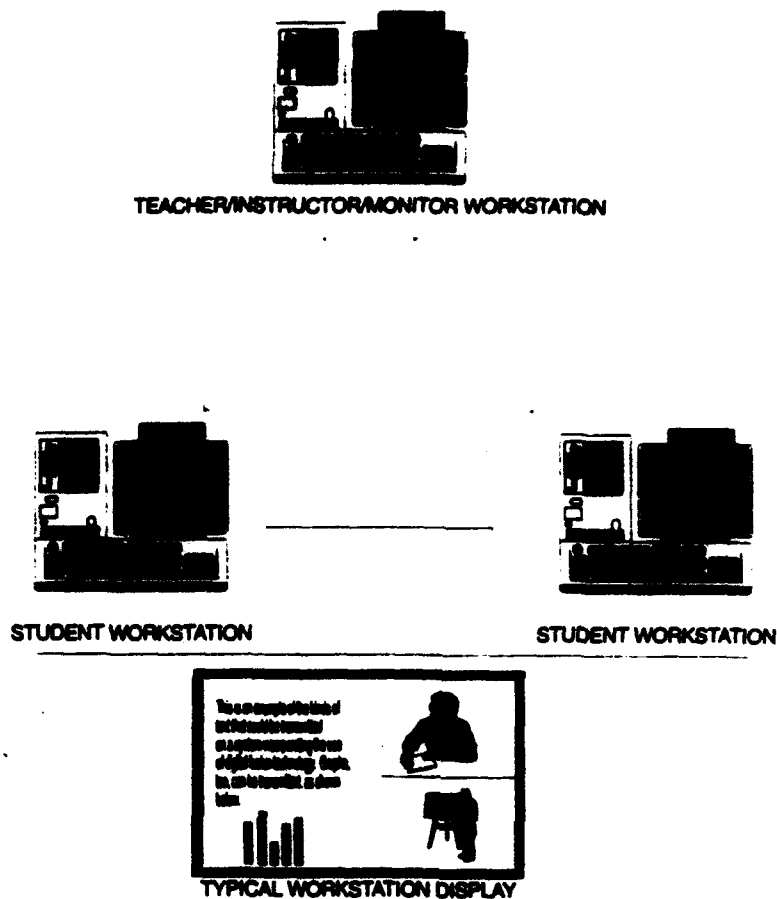


Figure 17. The Digital Fusion Concept of Distance Education.

D. COMPUTER-MEDIATED CURRICULA

1. Overview

Advances in computer technology have made it both possible and practical to engage in distance education via computer communications. Both traditional distance learning programs and "face-to-face" environments have limitations.

The features of a computer mediated communications (CMC) environment are varied according to the level of resources available to it. At the lower level, students receive instruction and/or are evaluated through simple question and answer formats on the computer. With the application of sufficient resources, the high-end of CMC learning can involve full motion video and access to vast amounts of information.

2. Applications

a. Computer Correspondence (E-Mail)

E-mail is the mechanism by which the traditional correspondence course has been translated for the computer age. As its name implies, electronic mail is a technology that utilizes a computer network (local or wide-area) much like a postal system.³⁰ Messages containing information in text, graphical, and even audio and video formats can be transmitted from one member of the network to another. In an E-mail environment, information can be transmitted from the instructor to the student and from the student to the instructor. It is not necessary for these communications to take place synchronously. In other words, the student and instructor can access the network at different times.

E-mail provides a significant timing advantage over conventional mails. Student and instructor responses and queries are available to their recipients immediately upon upload from the sender. "Message threads" are collections of messages between users that cover a specific topic. By tracing a message thread, it is possible for a member

³⁰ Mason, R., and Kaye, A., *Mindweave: Communication, Computers, and Distance Education*, Oxford, Pergamon Press, 1984.

to obtain every message left in the system from the initial to the latest query and response.³¹

b. Computer Conferencing

Until very recently, applications of computer conferencing technology were limited to E-mail message threads on a specific topic. Intel Corporation has just announced the development and pending release of a new hardware system that will allow real-time conferencing via computer.³² This is among the first generation of products embracing the concept of digital fusion. With this capability, computer conferencing moves toward the real-time capabilities of teleconferencing, while giving the users the ability to transmit a much greater range of data formats (text, graphics, audio, video) than are currently available in the teleconferencing medium. Another distinct advantage of computer conferencing is that the ideal model assumes that each user is at a workstation, and can communicate independently with other users (instructors or students). In the teleconferencing medium of communications, the normal approach has been to link large audiences in different geographic locales together with audio/video links. This is effective in terms of getting information and discussion to happen in real-time across a wide delivery area, but limits the amount of individual participation that can take place. With individual computer workstations, computer conferencing offers a very attractive medium for use in a seminar or symposium-oriented education or training environment.

³¹ **ibid.**

³² **ibid.**

c. Hypertext

Hypertext provides information through instantaneous connections known as hyperpaths.³³ This allows the user to move through materials as he or she selects rather than following a predetermined or computer generated path. Users of common desktop software such as spreadsheets or word processors will recognize the "HELP" function as a hypertext application. When the user enters the help application, he can use the mouse or keyboard to designate and select distinctive words and phrases in the displayed text. These linked words are commonly displayed in a different color than the rest of the text. When the user selects a hypertext item, the program displays the portion of the help application that the hypertext item is linked to.

The three elements of hypertext are individual files; the links that connect the files; and the user interface. The files make up the database; the links form the cross-references within the database so that any file can typically be accessed within a second. Far from being limited to the familiar help applications, hypertext applications are present in CD-ROM-based ICW, and use the same methodology anticipated in the operation of a digital fusion application.

Access and information structures closely resemble the adult learning process in terms of the cognitive skills that are developed and the cognitive processes that occur. Hypertext/hypermedia permit the learner to engage in discovery learning involving the

³³ Cherry, A., and Renckly, T., et. al., *Distance Learning: Curriculum Analysis and Media Selection*, Media Selection Guide, Air University, 1993.

continual construction and reorganization of knowledge to reflect the ways in which facts, concepts, procedures, and principles are organized in memory.

This technology is appropriate for delivering large amounts of information. It can be used for research and to maintain volumes of material, such as records, regulations, and procedures. Programs can be designed to allow users to access cross references and dictionaries of terms, and perform phrase and word searches without the forced linearity of traditional textual presentations.

d. Interactive Courseware (ICW)

Interactive courseware is a generic term for a wide variety of computer applications. They all have in common student inputs that determine the level, order, pace of delivery, and forms of outputs (print, message, text, graphics, video, audio). Several applications of interactive courseware are discussed in detail in this section (i.e., hypertext, computer simulation, computer tutorial).

Every ICW application utilizes a unique instructional design that affects development time, type of authoring system or language used, and equipment selection.

e. Computer Simulation

Defined as "an interactive educational experience based on a realistic representation of a system or situation that involves a game where users are in competition with themselves, other students, time, or the computer," this application allows the student to reach higher levels of learning (apply, analyze, synthesize, evaluate), increases the probability of long-term retention, and encourages

experimentation without expenditures of critical resources, such as fuel, planes, bombs, or troops.³⁴ It is an especially effective tool for practice of life threatening skills in a non-life-threatening environment, permitting repetition and critique after the fact. Simulations offer a real-world environment and allow very active participation. Educational games are very interactive, goal-oriented, and are usually offered at varying degrees of difficulty.

Simulation and gaming are useful techniques for teaching problem solving in which principle and process knowledge requires judgment (and/or interpretation) within the context of a specific situation. Student solutions can be compared to expert models and appropriate feedback given. These are both excellent for wargaming. Simulations can also be used to train procedural tasks and simulate equipment operation.

f. Computer Tutorial

In a computer tutorial-based curriculum, the material is often segmented into distinct units, with mastery of each unit being a condition for progress. Drill and practice routines or test questions are embedded within a section or at the end of a lesson to evaluate student progress and provide immediate feedback. Students advance at their own rate but do not control the scope and sequence of instruction. Depending upon the level of technology available, a computer tutorial curriculum can use text, graphics, animation, audio, and video, and will accommodate user input from a variety of devices.³⁵

³⁴ "Use of Technology in Defense Training," *Africa Intelligence Report*, June 29, 1993.

³⁵ Cherry, A., and Renckly, T., et. al., *Distance Learning: Curriculum Analysis and Media Selection*, Media Selection Guide, Air University, 1993.

This application of computer technology supports knowledge, comprehension, and application level cognitive objectives as well as lower level affective and psychomotor objectives. It can support higher affective and psychomotor levels when combined with simulation techniques. Remediation techniques can be built into the program to reteach those students who do not master objectives initially, with no penalty for repeated attempts. Practice sessions are embedded to provide feedback to both correct and incorrect user inputs. These individualized applications allow for privacy of response in a non-threatening environment.

An additional advantage to computer tutorials is the education management benefit. The tutorial program can track the progress of every participant, providing timely and accurate assessments upon which to base decision making.

At the high end of computer tutorial applications are programs that use the computer's processing ability and the information available on the student (provided by student input) to simulate the performance of an instructor in making decisions about the course of the learning process.

g. Computer-Based Job Performance Aids

A range of computer-assisted performance applications are designed to improve productivity and reduce error rates by providing immediate on-the-job access to integrated information and expert consultation with scope and sequence controlled by the user.³⁶

³⁶ *ibid.*

These applications are designed in a manner that reduces access time and improves comprehension. They can be applied during operations to help personnel perform in a more effective, timely, or cost effective manner. The high end application of computer-assisted performance technology incorporates rapid, on-line access of information, including hypertext and hypermedia, expert systems, such as tutorials, diagnostics, and coaching, and simulation and demonstration.

These applications increase employee competence by maximizing the transfer of skills and knowledge to the job setting. Education/training delivered in a classroom setting outside the context of the actual job or in an untimely manner may not be as effective (information that is not used or skills not practiced are often lost) as "just-in-time" training. Unnecessary learning is eliminated. Although originally designed for training, these applications can handle sophisticated decision-making processes and procedures. These systems can monitor student progress and make recommendations or predict possible outcomes. They are intended to advise the user and aid decision making rather than test.

h. Computer Aspects of Digital Fusion

Digital fusion is described as the convergence of computing, TV, printing and telecommunications. Each of these components has been significant in education and training. Bringing them together results in the whole having greater impact than each individual part and is one of the industry's most significant developments. The convergence of digital technologies and their use will impact the future of

teleconferencing, distance education and business.³⁷ Multimedia systems are those that are able to control some or all of the tasks associated with creation, development, production and post production via a single, easy-to-use, universal graphic console. Spurred by personal computing, desktop publishing brought to millions of users the ability to create high-quality printed materials at low cost. Digital fusion has given computers the ability to communicate and TV the ability to manage information. Importantly, digital fusion will give control to the non-specialist.³⁸ Just as desktop publishing opened publishing to ordinary people, desktop video will also open video to ordinary people.

The future is being shaped by new hardware and software that apply the personal computer's low-cost information management capabilities to television's uncanny ability to motivate and communicate. TV is not just video images. It is a complete commercial mass communications form, which includes sound, music, computer graphics, animation, and video, as well as highly developed styles of editing and production.

By joining TV and computers, the best aspects of each technology is combined. The result is a powerful communications and information system that joins TV's ability to introduce and highlight a subject with the computer's ability to provide in-depth information tailored to individual needs. The computer changes existing media

³⁷ Arnett, N., and Greenberg, M., "Multimedia Computing", Annenberg/CPB Project, Washington, D.C., 1989.

³⁸ Mason, R., and Kaye, A., *Minewaeve: Communication, Computers, and Distance Education*, Oxford, Pergamon Press, 1984.

by helping one find, store, search, and re-use many kinds of information. "Interactivity" is the term to describe this ability -- or need -- to control what is happening. Two-way communications have the highest level of interactivity, whether the communication is with a person or with a machine.

IV. IMPLEMENTATION CONSIDERATIONS

Lane reported studies determining what critical factors leaders of successful distance education programs considered to be important prior to, during, and following implementation of the program at their institution.³⁹

Thirty educational administrators, distance education specialists and program providers were invited to participate in a three round conference to determine the 20 critical factors that should be considered in the planning process to implement a distance education program at an educational institution. The 30 key leaders were asked with each Delphi round to refine and rank those critical factors that they listed. The final round produced 20 critical factors in rank order:

1. Identified need (perceived or real) for the program
2. Faculty and teachers supportive and given incentives for motivation
3. Funds for capital costs; production, equipment, facilities
4. Availability of on-going money for operations and expenses
5. Quality of the educational content of the program (evaluation)
6. Adequate support staff to produce the program
7. Ensuring equivalent learning experience to remote students
8. Enthusiasm and belief by the institution in the overall distance education project
9. Identification of a visible, spirited key leader/ administrator initiating program

³⁹ Lane, C., "Distance Education," *Telecomm*, 1993.

10. Adequate receive sites, facilities, and staff
11. Availability of appropriate and specialized equipment to deliver the programming
12. Sufficient time for careful needs analysis; identify the range of services and programmatic needs of students. Example: Number of people, type of course, ages served, location
13. Ensuring equivalent status for remote students; i.e., credit, degree, etc.
14. Instructional design and TV production: the interactive components, length frequency, and number
15. Identification of a marketing plan for the network, system or program. Public relations with the public
16. Cost effectiveness; feasibility and justification for delivery system to students and institution
17. Identified or gathered support/partners for the program: industry, corporate, legislative, institutional
18. Ensure continued credibility of the program with the public, faculty, students, and supporters
19. Knowledge of educational administrators, teachers and staff at educational institutions on what distance education is and how to teach and use it effectively
20. Ability to accredit course, offer credit or transfer credit across states or institutions.

These factors represent concerns of institutional management personnel who are used to a variety of circumstances that differ somewhat from those of the military environment, yet some of the issues with regard to funding are of similar concern in a time of shrinking defense budgets. In the interests of a more general framework, and in an effort to simplify the analysis of the issues, these factors can be translated into five general requirements for developing an implementation of advanced training technologies.

A. GENERAL REQUIREMENTS

1. Lead Time

There must be adequate lead time for the planning and implementation of both the curricular and technological aspects of a distance education or training program. Lead time considerations should begin with the development of behavioral objectives. Course content to meet those objectives must then be decided upon, along with evaluative criteria to measure the achievement of those objectives. A medium for conducting each phase of the course (from introduction and instruction through review and evaluation) must be decided upon. Once the medium has been determined, technological issues must be addressed to determine the overall feasibility and necessary actions for implementing the course.

All of these kinds of considerations must be dealt with in order to provide a coherent approach to education or training. The amount of lead time necessary will

depend on the complexity and level of the material, the technology employed, and the distribution of technology and information. The absolute requirement with regard to lead time, however, is that sufficient lead time be available to avoid trying to implement a partially developed course.

2. Availability and Affordability of Technology

Computer hardware and software requirements can include such items as information storage devices, processors, networking devices, other hardware, as well as the basic software required to enable the network system to communicate among its many terminals and devices. In the case of institutions with existing computer resources, these can be expanded to handle increased user loads, thereby avoiding the costly purchase of an entirely new computer network system. It is necessary that implementations of advanced technology in education and training employ technologies that are currently available, as opposed to technologies that are being developed. The primary consideration must be the ability of the program or course to reach educational or training goals, not the ability of technicians to meet technological requirements.

In addition to availability, the issue of affordability must be addressed. It is, of course, pointless for an institution to attempt a course of instruction utilizing a technology it cannot afford. Beyond this basic consideration, however, the issue of cost-effectiveness must be addressed. If expenditures on technology will enable an institution to fulfill its mission, it can sometimes be said that institutions cannot afford *not* to invest in technology. In the case of each program or course, the initial and ongoing

costs of technological implementations must be weighed against the benefits in achieving education or training goals.

3. Expertise for Development

With regard to the advanced technologies available for education and training discussed in this thesis, a wide range of general and specialized abilities are called for. From video production and broadcast, to programming of highly complex interactive systems, there is a great deal of expertise that is required. This is to say nothing of the curricular development skills that are required, for someone must be able to determine what to teach, how to teach it, and how to evaluate the effect of that teaching before a video producer or programmer can even begin the task of translating those education and training goals into the products for which they are responsible.

4. Abilities Required to Participate

Media technology has soared ahead of utilization. While media experts are using increasingly sophisticated technology, the fact is ignored that the teacher is bewildered by technology and still does not know how to use it.

Chu and Schramm (1967) found that instructional technology required instructors to learn new roles and processes that they tend to resist because they perceive difficulties in using new techniques.⁴⁰ Russell (1979) and Coder (1983) found that faculty tend to teach by lecture as they were taught, not as they were taught to teach by using media. Coder (1983) found that due to a lack of courses, faculty were unfamiliar

⁴⁰ Chu, G.C., and Schramm, W., *Learning from Television: What the Research Says*, Washington, D.C., National Association for Educational Broadcasting, 1967.

with learning theory, instructional design, or media utilization, a fact supported by Doerken (1977) who states that studies indicated that only 17 percent of all teachers had any training in the use of media. In 1983, Doerken reported that it would take an estimated \$400 million to provide training. During the 1984-85 Annenberg Study (Riccobono, 1986), about half of the institutions offered faculty only two to seven hours of training in media but ten to 15 hours of training in the instructional uses of computers. The figures did not report how many faculty members were trained.⁴¹ Bates (1987) observes that there is a major requirement to train instructors in the selection and use of media.⁴² Brey's 1991 study reported that opposition by faculty, administrators and boards of trustees is not an important impediment to starting programs; the cost of starting programs was the most often reported obstacle by community colleges.⁴³

Abilities of the instructor or program developer to produce an end product that meets the demands of the implementation must be considered, along with the ability of students or trainees to participate. As the implementation moves toward a more comprehensive communications platform, the abilities required of both the teacher or developer and student or trainee increase.

Another area that must be addressed in preparing an implementation of computer-mediated advanced training technology is the level of knowledge of the end user. Beyond "computer literacy," this consideration must include the level of

⁴¹ Lane, C., "Distance Education," *Telecomm*, 1993.

⁴² Bates, A., *The Open University: Television, Learning and Distance Education*, Open University, 1987.

⁴³ Brey, R., *U.S. Postsecondary Distance Learning Programs in the 1990's*, Instructional Telecommunications Consortium, Washington, D.C., 1991.

understanding that the end user currently possesses with regard to the specific subject material.

5. Overall Effectiveness

Overall effectiveness refers to the ability of the program or course to achieve its objectives. It is one thing to be in possession of a highly advanced training system, another to employ it, and yet another to say that, when it is employed, the result is good training. Generally, the overall effectiveness of an educational or training program can be measured by the evaluation results of its participants, but not always. If trainees score well on evaluations, and subsequently exhibit skills and abilities in keeping with the training standards, the overall effectiveness of the program meets criteria for success. If, on the other hand, evaluation scores are high but exhibited skills and abilities are lacking, there is an indication that something in the training program or course is flawed.

B. OBJECTIVES

Behavioral objectives provide the framework for the course and may help in the selection of the type of media and methods that are used in the course, as well as how testing will be constructed.

Behavioral objectives are also called learning, training, or performance objectives. They are an integral part of instructional design, but are equally important for the instructor and student working through the materials. Exact statements will help learners know how much they have accomplished and how much more they are required to learn.

Objectives are classified according to learning domain. Objectives are classified under the cognitive (knowledge) domain in which the learner might critique, analyze or evaluate something; psychomotor (skills) domain in which the learner might operate equipment or coordinate; and affective (attitudes) domain in which learning might show, demonstrate or exhibit a change of attitude or outlook through specific behaviors.

Objectives in the cognitive domain include all task performances and behaviors that use knowledge of certain information. This domain may involve knowledge of terminology, specific facts, conventions, trends, classifications, methodology principles, generalizations and theories. Objectives in the cognitive domain can be used to: develop classroom instruction; organize instructional content on the basis of increasing difficulty of subject matter; and describe intellectual aspects of learning such as knowledge, information, thinking, naming, solving, analyzing, evaluating and synthesizing.

Objectives in the psychomotor domain focus on skills. Performance requires adept use of objects, tools, supplies, machinery or equipment. Statement of psychomotor performances include constructing models or operating a computer. Objectives in the psychomotor domain can be used to: focus on actual skill performance; focus on the finished product; and specify accuracy within limits, level of excellence and speed.

The psychomotor domain includes everything from mechanic and equipment operator to computer operator and even fighter pilot.

Objectives in the affective domain require demonstrations of attitudes, feelings and emotions. They enable instructors to identify aspects of instruction that can help learners

on a personal or social level. An example might be to increase collaborative team skills. These objectives involve paying attention to people and events, responding to them through participation, expressing values by showing either support or opposition and acting according to those values. Objectives in the affective domain can be used to: demonstrate listening, perceiving, tolerance and being sensitive to someone or something; show a willingness to cooperate, follow along, reply, answer, approve and obey; select, decide, identify and arrange values in order of importance as they relate to specific situations; and translate feelings and attitudes into observable behaviors.

C. TQL/TQM OBJECTIVES

On October 3, 1989, Robert W. Galvin, chairman of Motorola Corporation, addressed the 5th National Quality Forum in New York. In describing Motorola's emphasis on continual training, Galvin suggested that executives plan to work for ten months a year, spend one month in training programs, and enjoy one month on vacation. Business demand, he continued, might cut into vacation time but shouldn't be allowed to cut into training.

In order to implement total quality management or total quality leadership objectives, managers and employees must receive training in the concepts. In addition, TQL/TQM principles dictate that each and every member of an enterprise be given the best available tools to work with in order to ensure a quality result. The most important of these tools are availability of training and training resources. Advanced training and

education technologies promise to make achievement of these training objectives possible.

A world class firm continually trains its people and develops their talents. For the employee, it is not so much job security as work-life security, because the high level training received contributes to the employee's net value as a trained asset.

A refresher course on installation procedures for a specific piece of equipment could be accomplished by incorporating a time/accuracy competition over a teleconference network. In this scenario, a number of teams in a variety of locations could compete for best score. The competitive nature of the evaluation would yield improved teamwork and boost morale.

D. BENEFITS

A key issue in favor of advanced technologies in training programs is that of timing. Advanced technologies can ensure that training is always available. This is known as *asynchronous* communications, because it is not necessary for two people to be active in the system at the same time in order to communicate. With the advent of education and training via E-mail, each student in a given course of instruction can send questions to the instructor at any point in time. Likewise, the instructor can "leave mail" for the students whenever it is necessary.

Another timing issue has to do with feedback. When evaluations are performed via computer (given that it is an ICW-based evaluation program and not an assignment

submitted via E-mail to the instructor), the feedback for the student is immediate. There is no need to wait for the grading period required by most forms of standardized testing in use today.

The existence of advanced technologies provides great assistance in the area of education management. Because all learning progress and results of examination can be recorded automatically by computer at the time of occurrence, collating those results and providing statistical indicators of the general effectiveness of the course is a matter of making the correct requests of the computer. This allows managers to make prompt decisions and take advantage of the speed with which changes can be implemented in an advanced technology curriculum.

Another advantage to learning in an advanced technology curriculum is pacing. In the traditional learning environment, the entire class moves from one activity to another. In a technologically advanced environment, each individual is able to move through the course of study at his own pace. It is generally accepted that this produces a more productive learning experience.⁴⁴

Another advantage of the use of computers is flexibility. Because the course and exam content can be centrally controlled, a standard level of instruction and evaluation can be achieved. Updates and revisions of the course and evaluation program content can be easily made when the education or training program utilizes advanced technologies.

⁴⁴ David, L.E., "Facilitation of Adult Learning through Computer-Mediated Distance Education," *Journal of Distance Education*, University of Guelph, 1987

Additionally, one system can accommodate a variety of users. For instance, a computer network system or video distribution system installed to provide training to typists can also be used to train mechanics, provided the appropriate programs are designed and installed and the overall resources of the system are sufficient for the purpose.

Another TQL/TQM advantage to the implementation of advanced technologies in training programs for the CAF is the improved ability to statistically measure and evaluate ongoing training. Whether viewed from the point of evaluating a trainee or an entire training program, the use of computer technology to administer testing/evaluation allows ready access to and manipulation of statistical information.

One often overlooked application for training technologies is their ability to provide instruction on how to use the system itself. In other words, a trainee's first experience on a training system could be an automated introduction to the system and instruction on operating procedures. The system could even conduct an evaluation of the trainee or student's ability to operate in the training environment, enabling remediation of lacked skills and/or knowledge and only allowing access to actual training issues when a minimal skill level has been reached.

E. SELECTED APPLICATIONS

1. South African Defense Applications⁴⁵

In South Africa, training is a priority issue that is complicated by increasing demands and decreasing funds with which to address them. Wherever possible, the South African Defense Ministry emphasizes investing in training technologies that will increase performance and give cost effective results over time.

The research and training wing of the army's infantry school has developed several training programs that take advantage of advanced technologies and can be integrated into larger training and training management systems. Many of their cost and benefit requirements are met through simulation-based training programs. In addition to tactical simulations run on computer, training in weapons operations, from firing the infantry's basic assault rifle to operating very complex (and expensive) missile systems, is accomplished through the use of simulation.

Not only do the South Africans use video and computer-based simulations, but they are currently developing a new application for assault rifle training that incorporates a simulated weapon that fires a laser and delivers a kick upon firing that is identical to that exerted from the genuine rifle. Additionally, this training system would not be connected to a central station by wire, thus enabling use of the simulator rifle in tactical exercises over obstacle courses and open terrain.

⁴⁵ "Use of Technology in Defense Training," *Africa Intelligence Report*, June 29, 1993.

2. Management Education via Satellite in India⁴⁶

In New Delhi, India, the All India Management Association sponsored a tele-seminar over a three day period. The program was broadcast via satellite to 10 remote locations across the country and involved over 500 students.

This venture was conducted in collaboration with the Indian Space Research Organization (ISRO) and Indira Gandhi National Open University (IGNOU). The program was a pilot for the Satellite Based Network for Education and Training (SINET). The ultimate aim of the program will be to offer graduate education courses in a wide variety of curricula.

The course was transmitted using one-way video and two-way audio, and had the additional benefit of a FAX link at all locations.

3. Pacific Bell Knowledge Link⁴⁷

In 1994, Pacific Bell will begin to install 300 dedicated workstations in its facilities throughout California. These workstations will be used by employees to train in critical skills without an instructor. The company will use the training system to enhance the skills of its telephone technicians, customer service personnel, and personnel charged with other functions, such as accounting, finance, and administrative support. The interactive courseware will employ text, still video, sound, graphics, and several different types of animation.

⁴⁶ Mahabharat, C.T., "India - Management Education via Satellite," *Newsbytes News Network*, November 17, 1993.

⁴⁷ "Pacific Bell Uses ISDN, New Software for Employee Training," *Education Technology News*, September 28, 1993.

Pacific Bell training personnel will use a commercial authoring package to build the programs, and copies of the programs will be loaded onto each workstation. By using this system, that Pacific Bell is calling its "Employee Knowledge Link," the company expects to save \$18 million over the next six years.

4. Computer Based Training in the Banking Industry⁴⁸

The Performance Support Group of NSS Corporation, which is a company providing computer systems for banks, has reevaluated its methods for training personnel on newly installed systems. They used to provide seminar courses to introduce the procedures and capabilities of the system, but after conducting extensive surveys, have revised their approach.

Technical training is now built into the packages provided to banks upon installation of systems. Over a period of a few days, bank personnel are introduced to the systems by encountering real life business situations and problems. The scenarios are part of the package that is loaded onto the machines, and by turning on the machine for the first time, the employee begins the training process.

The systems are customized prior to installation, so that the specific bank's forms and procedures are available immediately. This presents a long-term training advantage in that subsequent hires can be trained on the system (and all of the bank's procedures) by the system itself.

⁴⁸ Zhongguo Xinwen She, "Activities to Popularize Computer Education Viewed," *International Intelligence Report, Inc.*, 1993.

The popularity of such computer-based training (CBT) is growing. The NSS support group reports that more and more banks are making inquiries on how to purchase and begin using their own authoring software to develop CBT applications.

5. Union Pacific Railroad ICW⁴⁹

The Denver Estes Park Railroad program, designed for Union Pacific Railroad, is a videodisc-based financial simulation program that uses role-playing techniques to teach business operations. Topics include understanding tax laws, operating expenses, stocks and dividends, and generating new revenues.

6. US Air Force Maintenance Training System⁵⁰

The US Air Force MCPT maintenance training system uses "knowledge engineering" to train novices to think like experts. An F-15 landing gear troubleshooting simulation, the MCPT system comprises 21 courses, offering more than a trillion decision points. Student performance is tracked along a "mental map," which compares student performance to the expert data base, thereby helping to improve cognitive path analysis of problem solving skills. Among the first 167 students using the courses, a 93% mastery level was achieved.

7. Mind Extension University⁵¹

ME/U was launched in 1987 as a basic cable television channel. Originally, the network's programming focused primarily on for-credit, college-level telecourses in such

⁴⁹ Kasten, A., Reeve, V., and York, R., "SALT: Interactive Multimedia," *Multimedia and Videodisc Monitor*, November, 1993.

⁵⁰ *ibid.*

⁵¹ Lane, C., "Distance Education," *Telecomm*, 1993.

areas as science, fine arts, English, mathematics, foreign languages, and general business, as well as pre-college and self-enrichment education. It has broadened its course offerings to meet the needs of elementary and secondary school students and their teachers. All credit courses are led by course instructors from prestigious colleges and universities across the nation. Each course requires textbooks, assignments, and exams. Direct or two-way contact with instructors is handled by mail, phone, and in many cases, teleconference. Once a student completes a course, credit is granted by the institution offering the course. It recently added an MBA program.

8. University of Phoenix Online Division⁵²

The University of Phoenix Online Division in San Francisco offers graduate and undergraduate degrees in business entirely through computer conferencing. Called "online" because it relies on computer-mediated communications, the courses are uniquely interactive. Students are not isolated from one another, and they are able to benefit from each other's wealth of experience and knowledge. Online students participate in class groups composed of 8 to 12 working professionals from around the country. Because the online "classroom" is open 24 hours a day, students have the flexibility to schedule their learning time around their other commitments, including extensive travel. Because the program is asynchronous, students can log on to the system anywhere and anytime they have access to a computer, modem and telephone line. Faculty members are also scattered throughout the US. Before beginning to teach on the system, instructors receive two weeks of training on the system, adult education methods,

⁵² *ibid.*

and interaction skills appropriate to the computer conferencing classroom. Faculty and administrative meetings are held on the system as well. A second distance education division within the University of Phoenix is called the Access Division. It utilizes an audio-graphics system for directed study programs.

9. Laredo, Texas Nursing Program⁵³

A solution to the nursing shortage in Laredo, Texas was created through a joint effort between San Antonio's Incarnate Word College and Laredo Junior College. Students in Laredo link with students and teachers on the Incarnate Word College campus in San Antonio through an interactive two-way video classroom that will help prepare nurses to receive their bachelor's or master's degrees. A major benefit of the link is the ability to attend classes in Laredo while earning their bachelor's or master's degrees. This capability is crucial to retaining graduating nurses who will remain in Laredo to serve the health care needs of the community with their advanced skills.

⁵³ *ibid.*

V. A PROPOSAL FOR CAF TRAINING SYSTEM

A. OBJECTIVES

The exercise presented in this chapter is intended to illustrate a possible methodology for the integration of advanced technologies in the CAFs officer training program.

The following two sections discuss system and organizational considerations that would have to be addressed in an implementation of advanced technologies in CAF officer training. After that, there are two sections discussing a prototypical six phase implementation. The chapter concludes with a discussion of additional implementations and considerations, and a final section on the evolution of advanced technology applications.

B. SYSTEM CONSIDERATIONS

The first step in implementing advanced technologies in training and evaluation in the CAF will involve a determination as to whether or not it will be necessary to make additions to the equipment currently being used. One of three options is possible. The first of these would be to design and implement a training and evaluation system that utilizes only the currently available CAF resources. The second would be to augment current resources with additional equipment to accommodate transmission equipment,

software, terminal, and storage demands. The third option would be to purchase additional equipment to establish and maintain an entirely separate collection of resources to use in training and evaluation.

The first option outlined above could only be undertaken with the assurance of the current network administrators that the increased demand on the CAF computer system would have no negative effect on the current level of operations. This is unlikely, given the volume of traffic and information that can be expected to arise as a result of implementing a computer-based system. Both the first and second options bring up the issue of security, as it would be unwise to increase the level of security risk on the CAF computer network system by expanding access to it through the new training and evaluation program. The third option is the most expensive method of the three. When one considers the savings to be derived from centralization and automation of training and evaluation procedures, however, the third option may not be so expensive after all.

Whatever the eventual decision of the CAF command, the training and evaluation system will have to be designed around the limitations and capabilities of the hardware and software system resources that are available. In this proposal, it will be assumed that the computer aspect of an advanced technology approach to training and evaluation will be made possible by augmenting the existing CAF computer network.

C. ORGANIZATION

1. Headquarters Training Section

Management of the new training and evaluation system will be accomplished by the CAF Headquarters Training Section. Under this proposal, the Headquarters Training Section will be reorganized, as shown in Figure 19. This section would be much more streamlined than the one currently in place, resulting in manpower savings. Additionally, moving to a training and evaluation system that takes advantage of advanced technologies would eliminate the need for the two training officers at each Section, Headquarters, and Air Base facility.

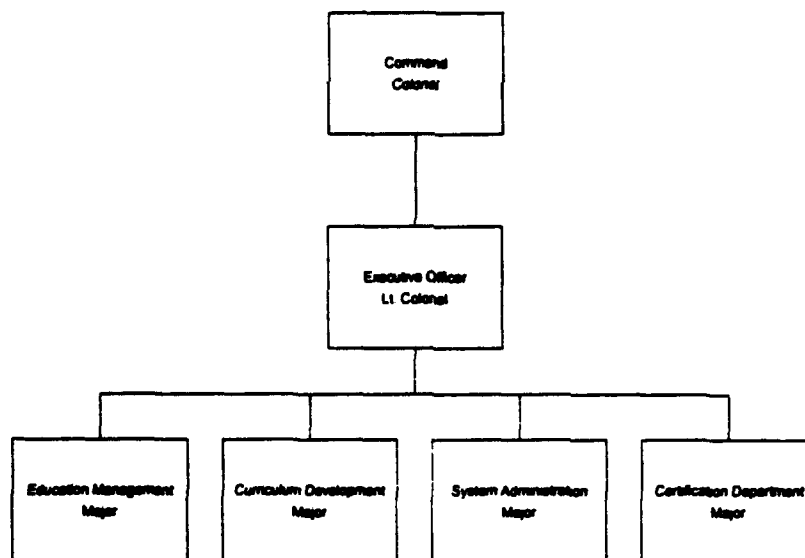


Figure 19. Proposed Organization of Headquarters Training Section.

The new Headquarters Training Section will be comprised of a Colonel in command, a Lt. Colonel as Executive Officer, and four Majors, managing the four departments of the section: Education Management, Curriculum Development, System Administration, and Certification.

2. Training Levels

This proposal includes a modification of the levels of officer training being used by the CAF. Instead of three training levels (Primary, Advanced, and Quality), this proposal offers four (Level I, Level II, Level III, and Level IV). There are two primary reasons for this. First, it is anticipated that the employment of advanced technologies will result in more distinctive instruction objectives and evaluative criteria. Second, the multi-phase implementation is made more feasible by further dividing the levels of training, as each training level will affect fewer personnel than if there were only three levels.

3. Curriculum Boards

a. Purpose and Organization

The content of each course of instruction will be determined by a Curriculum Board established for that purpose. Each Curriculum Board will be composed of 7 members, as shown in Figure 20. A Curriculum Board will exist for each of the nine major areas of officer training. For each board, the membership will be determined on a rotating basis. In the first year, for instance, three representatives of the faculty of the school concerned with the board's focus area (i.e., Administrative Management, Medical,

Logistics, etc.) will meet, along with three senior experienced officers from that area and the Major who heads the Curriculum Development Department of the Headquarters Training Section. In the next year, three different representatives from the school faculty will join three different senior experienced officers and the Major. In this way, different areas of expertise will be evidenced in the training and testing over time, and individual biases can also be removed.

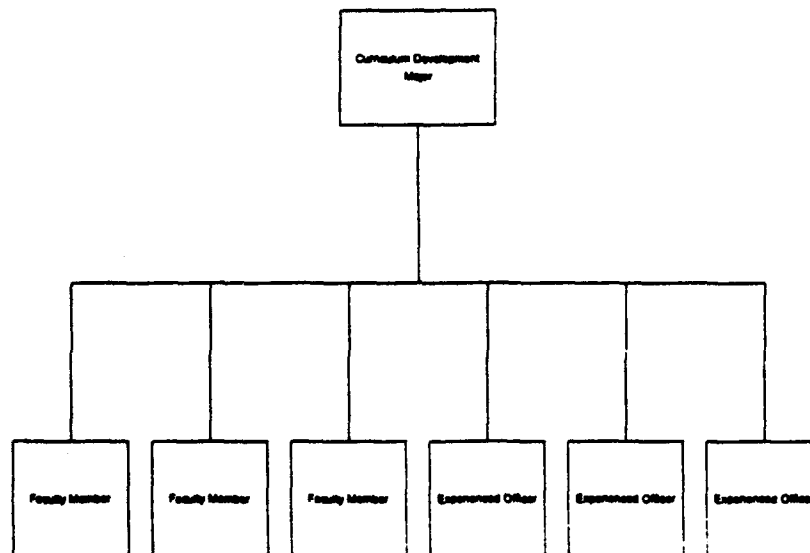


Figure 20. Proposed Curriculum Board Organization.

Each Curriculum Board will have two primary responsibilities, training programs and evaluation programs. The workload for the first year's board will be extensive, because they will be creating the entire training and evaluation programs. In subsequent years, the Board's responsibilities will be confined to making changes in the established training and evaluation programs (i.e., adding or deleting content of the training programs and the test questions).

b. Training Programs

The first task of the Curriculum Board is to establish the year's training program for each specific area within the major area of the Board's concern. For instance, the Administrative Management Curriculum Board will establish a training program for the each of following specific areas: General Administration, Typist, Security Management, Financial Management, Accounting Management, and Audit Management.

There will be two major influences in the Board's deliberations. First, the academic knowledge and background of the Training School Faculty Members will come into play. Secondly, the practical experience of the senior experienced officers on the Board will add to the Board's considerations. The Systems Administration Department of the Headquarters Training Section will be able to advise the Curriculum Boards of what is and is not available in terms of the system's capabilities. In the beginning, training and evaluation programs will probably be limited to question, review, and answer functions, but as the system is developed and more resources and technology can be applied, it can

be assumed that the flexibility of the system will be enhanced so that it can achieve even greater accuracy with regard to training and evaluation goals.

The training programs will all be self-paced, and constant access to the training and evaluation areas will mean that there are no limitations on the officer's ability to receive training. Additionally, if the system is established as part of the existing CAF computer network, individuals will be able to use computers located in each office on every Air Force installation, all of which will also be connected to the system.

c. Testing Programs

Under the new program, another function of the Curriculum Boards will be to design the testing program that each officer will take via computer to attempt certification at the relevant level (Level I, Level II, Level III, Level IV). For each specific job category, the Curriculum Board will assemble 150 questions designed to measure the capabilities of the officer in relation to his or her specific job. The computer-mediated evaluation will consist of the applicant sitting down at a personal computer or terminal in the Training and Evaluation Area at the officer's location. The identity of the testee will be verified by the individual supervising the area, and the testee will proceed by replying to prompts on the computer. Each testee will have the opportunity to answer 30 questions selected at random from the 150 that have been posted to the testing program. Testees who provide incorrect responses six times will be considered to have failed the test, and must undergo remediation before being allowed to take the test a second time.

d. Additional Evaluation

In addition to determining the content of training and evaluation programs, the Curriculum Board will have the responsibility of determining whether additional evaluation is necessary. In the case of some occupations (such as Fighter Pilot), this may include a personal performance evaluation performed by a qualified officer, supervisor, or instructor. In other cases (such as Political occupations), the testee may be required to submit additional proof of ability (such as an essay submitted to a designated committee established by the board).

e. Remediation

The Curriculum Board will also have the duty of creating a specific program that is designed to remediate individuals who fail in their first attempt at testing. The program for remediation will be in the same format as that used for training, but flexibility in system design may allow for the program to automatically focus on areas in which the testee experienced problems during the first attempt.

4. The Certification Department

The Certification Department of the Headquarters Training Section will issue all official certifications relating to an individual officer's abilities. The Major in charge of the department, along with two Captains to assist him, will collate the results of CMC training completion to authorize individuals to test. After the CMC testing results are determined, this department will also be responsible for obtaining the results of any other required evaluations before issuing a notice of certification, or a directive for remediation.

5. Education Management Department

The work of the Education Management Department will be done by a Major with assistance from two captains. Directives for this department will come from two General Officers, the General in Command of the Operations Division of the Air Force and the General in Command of the Education Division of the Air Force. The primary responsibilities of this department will be to perform investigations of the Air Force-wide pass/fail rates of officers in training and to measure the actual abilities of officers who have received certifications. This latter function will be useful in determining whether or not the training and testing systems are satisfactory. For instance, the Education Management Department could arrange for instructor pilots to evaluate the performance of pilots certified at the Quality Level in order to determine whether that rating is indicative of their true abilities.

The Education Management Department will issue recommendations to the Curriculum Boards based upon the directives of the Operational and Education Commanding Generals, the statistical results of their survey efforts, and the prevailing policies of the Central Command. In their most basic form, these recommendations might be "increase the difficulty of Advanced Level Pilot Evaluations," or "increase the level of training given to General Administrative Officers."

6. The System Administration Department

This department will be run by a Major. There are basically two options for the day to day operation of this department. On one hand, the maintenance and programming

activities required by the training and evaluation system could be performed by a civilian contractor, in which case the Major will serve as a liaison. On the other hand, the Central Command may decide to task military personnel with these responsibilities, in which case they will come under the direct supervision of the Major.

The System Administration Department would also handle issues relating to production of training systems (from printed materials to video and ICW applications). Initially, the demand will be for basic programs to handle review and evaluation. As the implementation of technology continues, however, very skilled personnel (whether military or civilian) will be required to translate the training objectives, methods, and information provided by the Curriculum Boards into effective interactive courseware applications that incorporate the full range of media manipulation that can be exploited through the application of telecommunications and computer processing technology.

One of the initial questions to be dealt with by the Systems Administration Department is where to locate ICW programming. The programs could be located at a central processing site, with workstation users accessing that site to engage in ICW training. Alternatively, training programs can be placed on CD ROM and distributed to Installation Training Centers as appropriate.

7. Installation Training Centers

The Installation Training Center (ITC) will serve as the initial method of delivery of advanced technology training applications. As the multi-phase implementation progresses, it may be possible to incorporate other methods of delivery to

maximize the effectiveness of the program and ensure wide-spread use of technological resources to justify the expenditures necessary to pursue those technologies.

An ITC should have the minimum requirements of multiple workstations through which to access network and ICW resources and a method of audio/video delivery. This may mean two large areas: one devoted to housing twenty-five computer workstations; the other a room with seating and audio/video playback equipment. Resource allocation will play a great role in determining the number of workstations and display stations available. Translated in terms of the demand on that availability, this information will have an impact on the curriculum designers in that a certain amount of time will be available to pursue each training objective in a given curriculum.

Continued pursuit of technological advances in training will lead to an increasingly adept and efficient officer corps. This may one day justify ensuring that each officer in the CAF has access to a workstation and the network, which would eliminate the need for the ITC's as envisioned in the initial implementation outlined in this chapter.

8. Additional Manpower Requirements

In addition to the Headquarters Training Section, the Curriculum Boards, and the individuals (military or civilian) tasked to respond to system maintenance needs, there will be a need for a site administrator for each of the training and evaluation areas established under the new system. These individuals will handle scheduling and routine

maintenance of the terminals at their location, in addition to verifying that testing procedures are followed.

D. INITIAL IMPLEMENTATION CONSIDERATIONS

A detailed project calendar for employment of a computer-mediated training and evaluation system within the CAF computer network is beyond the scope of this thesis. Before the Curriculum Boards for each major occupation area can meet to determine curricular requirements of the system, the arrangement for how best to phase in the training and evaluation system must be decided on.

It is suggested that the best way to do this would be for the officers of the Headquarters Training Section to meet with each of the superiors of the training schools to discuss logistical and academic concerns. These officers could then prepare a proposal for the consideration of the Commanding General of the Education Division and the Commanding General of the Operations Division of the CAF. Upon approval, the implementation of the training and evaluation system could begin.

It is assumed that the eventual schedule of implementation will allow for a smooth transition between the new system and the old. By allowing the first year Curriculum Boards for each major occupational area to have additional time and resources to complete the first training and evaluation program for that area, a better first effort toward a computer-mediated system will be made. Additionally, phasing in the different areas over time will allow for a more smooth movement from the old system.

Whether the CAF employs civilian contractors or properly trained military personnel, the Systems Administration Department will have to work very closely with the Curriculum Boards in order that each will have more knowledge about the needs and abilities of the other. A method of approach to properly orienting the Curriculum Board members might result in a reasonable methodology for a general system orientation program. Another variable in the implementation process will be the time and expense necessary to install additional hardware and software on the CAF computer network.

E. MULTI-PHASE IMPLEMENTATION SCHEDULE

The following phases of implementation describe a program whereby videotaped instruction and interactive courseware (from simple review and evaluation questions to complete, interactive courseware) are implemented in six stages across four levels of training. Videotaped instruction was chosen as an intermediary stage of development because of the relative ease of production and use, and the fact that any resources used can be passed on to other training areas (i.e., enlisted training) when the multi-phase implementation moves on to other technologies. The ICW component of the implementation moves in the direction of computer-assisted learning that will dominate future training applications.

1. Phase I

In Phase I, an automated review system will be implemented at Level I training locations. This will mean the establishment of an Installation Training Center at both the

two schools and the academy of the CAF. The purpose of the ITCs will, at this phase, be limited to providing workstations upon which students can measure their skills prior to taking the Level I Evaluation Exam (which is currently known as the Primary Training Test).

This phase of implementation will require the Curriculum Board for each career specialty to identify appropriate review questions to measure the level of achievement of Level I trainees. Likewise, the System Administration Department will have to develop the programming necessary to administer these automated reviews, utilizing the review questions developed by the Curriculum Boards.

TABLE II. PHASE I IMPLEMENTATION

Implementation -- Level I

Automated Review System

Curriculum Requirements -- Level I

Review Questions

Technology Requirements -- Level I

Testing Terminals

Evaluation Software

Communications with Headquarters Training Section

An additional technical requirement will be to have communications between the ITCs and the Headquarters Training Section so that results can be transmitted from the ITCs to be analyzed by the Evaluation Department. The analysis of results collected

during the Phase I implementation will be helpful to the Curriculum Boards in developing additional materials and standards for subsequent phases.

2. Phase II

Phase II will continue the development of the ITCs at the two CAF training schools and the academy by incorporating videotaped instruction for Level I learning objectives. Additionally, Level I trainees will take the Evaluation Exam on the ITC workstations, eliminating written tests for Level I trainees. Level II trainees will begin using the ITC workstations to answer review questions, just as Level I trainees did in Phase I.

TABLE III. PHASE II IMPLEMENTATION

Implementation -- Level I

Automated Review System
Video Training Courses
Automated Evaluation System

Curriculum Requirements -- Level I

Video Course Content
Review Questions
Test Questions

Technology Requirements -- Level I

Video Display
Testing Terminals
Evaluation Software
Communications with Headquarters Training Section

Implementation -- Level II

Automated Review System

Curriculum Requirements -- Level II

Review Questions

Technology Requirements -- Level II

Testing Terminals
Evaluation Software
Communications with Headquarters Training Section

The Curriculum Boards will have to develop the content of the videotaped instruction for Level I training, and the tapes will be produced by the Systems Administration Department. The Curriculum Boards will also be responsible for developing the Evaluation Exam questions, and modifying the review questions from Phase I, as appropriate. In addition, they will begin work on Level II training by developing Level II review questions.

The primary technological requirement of Phase II will be to open Installation Training Centers at the remaining CAF facilities (remaining nine CAF installation locations). Additional technological requirements of Phase II implementation will be equipment with which to produce and view instructional videotapes. Also, the central system will have to be developed to the point where it can accept and manipulate test results and maintain records of training progress.

3. Phase III

Phase III will extend the use of automated review at ITC workstations to Level III trainees. For Level II trainees, Phase III will extend the use of automated testing and videotaped instruction. For Level I trainees, videotaped instruction will be replaced by interactive courseware.

Phase III implementation will require the Curriculum Boards to identify Level III review questions, Level II test questions and videotaped course content, and the content of Level I interactive courseware.

TABLE IV. PHASE III IMPLEMENTATION

Implementation -- Level I

ICW

Curriculum Requirements -- Level I

ICW Curriculum

Technology Requirements -- Level I

ICW Workstation

Implementation -- Level II

Videotaped Instruction

Automated Review

Automated Evaluation

Curriculum Requirements -- Level II

Video Course Content

Review Questions

Test Questions

Technology Requirements -- Level II

Video Display

Testing Terminals

Evaluation Software

Communications with Headquarters Training Section

Implementation -- Level III

Automated Review System

Curriculum Requirements -- Level III

Review Questions

Technology Requirements -- Level III

Testing Terminals

Evaluation Software

Communications with Headquarters Training Section

The technical requirements of Phase III may mean enhancing the ITC workstations to be able to provide better processing and/or peripheral ability for ICW applications (i.e., upgrade processors, increase memory, add CD ROM capabilities). Of

course, Phase III will offer the Systems Administration Department its first opportunity to develop programming for interactive courseware. Additionally, the Systems Administration Department will have to continue to monitor the demands upon the system to ensure that central storage and processing requirements can be met.

As with each phase of implementation, a suitable review of progress will have to be made to determine methods for enhancing the training programs prior to Phase IV implementation.

4. Phase IV

Phase IV will introduce Level IV trainees to automated review, extend videotaped instruction and automated testing to Level III trainees, and allow Level II trainees to join Level I trainees in the use of interactive courseware.

The Curriculum Boards will have to develop review questions for Level IV trainees, videotape course content and test questions for Level III trainees, and course content for ICW applications for Level II trainees.

The increase in technical demands accrued in Phase IV will be more quantity than type, because the range of technology to be used over the entire multiphase implementation will already have been reached for Level I trainees with ICW. However, the job of maintaining the system as it grows to provide ICW at all training levels should be enough to keep the System Administration Department busy.

TABLE V. PHASE IV IMPLEMENTATION

Implementation -- Level II

ICW

Curriculum Requirements -- Level II

ICW Curriculum

Technology Requirements -- Level II

ICW Workstation

Implementation -- Level III

Videotaped Instruction

Automated Review

Automated Evaluation

Curriculum Requirements -- Level III

Video Course Content

Review Questions

Test Questions

Technology Requirements -- Level III

Video Display

Testing Terminals

Evaluation Software

Communications with Headquarters Training Section

Implementation -- Level IV

Automated Review System

Curriculum Requirements -- Level IV

Review Questions

Technology Requirements -- Level IV

Testing Terminals

Evaluation Software

Communications with Headquarters Training Section

5. Phase V

Phase V will continue the application of ICW in training at Levels I and II, and extend it to Level III. Level IV trainees will begin to use automated testing and videotaped instruction.

The requirements of the Curriculum Boards for Phase V, in addition to their ongoing review and maintenance of the content of all instruction and evaluation, will be to develop the video course content for Level IV trainees and the ICW content for Level III trainees.

TABLE VI. PHASE V IMPLEMENTATION

Implementation -- Level III

ICW

Curriculum Requirements -- Level III

ICW Curriculum

Technology Requirements -- Level III

ICW Workstation

Implementation -- Level IV

Videotaped Instruction

Automated Review

Automated Evaluation

Curriculum Requirements -- Level IV

Video Course Content

Review Questions

Test Questions

Technology Requirements -- Level IV

Video Display

Testing Terminals

Evaluation Software

Communications with Headquarters Training Section

6. Phase VI

The multi-phase implementation will conclude with the introduction of interactive courseware for Level IV trainees. This will be the final initial development content for an ICW application by the Curriculum Boards.

At the end of Phase VI, all four training levels for officers in the CAF will incorporate ICW, and all testing will be by automated methods on the workstations (except for the additional evaluations required by the Curriculum Boards for things like flight skills, etc.).

TABLE VII. PHASE VI IMPLEMENTATION

Implementation -- Level II

ICW

Curriculum Requirements -- Level II

ICW Curriculum

Technology Requirements -- Level II

ICW Workstation

Implementation -- Level III

Videotaped Instruction

Automated Review

Automated Evaluation

Curriculum Requirements -- Level III

Video Course Content

Review Questions

Test Questions

Technology Requirements -- Level III

Video Display

Testing Terminals

Evaluation Software

A complete review of the strengths and weaknesses of the training programs should be undertaken before proceeding with any further implementation of training technologies to ensure that goals are being met in an efficient and cost effective manner.

F. ADDITIONAL AREAS OF IMPLEMENTATION

1. Conferences and Seminars

The implementation of technology can be applied in many other areas. As the training program evolves, the acquisition of audio/video transmission equipment will enable teleconferences to take place across distances of separation. This will enable, for instance, timely transmission of revised procedures to operational units, as in the case of a new procedure for flight mechanics.

2. Simulations

There are many possibilities to incorporate computer simulations in training. For a start, the existing simulations (such as flight simulators) can be configured to transmit performance data to the central system for collation, analysis, and record keeping. As the implementation of technology evolves, more and more activities can be incorporated into the simulated training environments, which will ultimately result in substantially reducing the cost of training.

3. Higher Education

The implementation of advanced technologies can result in additional traditional education benefits. In collaboration with private institutions, computer and video training

can be configured to interface with a private institution's curriculum. This will enable CAF personnel to pursue educational goals that they might not otherwise have the opportunity to explore.

4. Communications

As the system becomes more advanced, the communications capacity of the implementation can be explored. For instance, each officer can be issued a unique identification number. When the need arises to brief every officer on a specific policy or procedure, each officer can go to a workstation and enter identification information, whereupon the system will display the relevant information and record that the officer was briefed.

5. Other Military Branches

Once the framework of the training technologies has been developed in the CAF officer training program, proliferation to other branches of the military will be possible. There are currently a wide variety of military training programs in use and being developed around the world.

6. Non-Commissioned Officer and Enlisted Training

As the system evolves toward digital fusion, lower levels of implementation can be extended to Non-Commissioned Officer and Enlisted Training. For instance, the multiphase proposal outlined in this chapter employs videotaped training only as an intermediary step. All of the video production and replay equipment can be used for subsequent training implementation in the lower ranks.

G. MITIGATING COST

The costs of implementing advanced technology in CAF training can be mitigated in several ways. First, one must consider the cost savings to be achieved through the implementation of more efficient technology. Second, the increased effectiveness of training will lower operational costs over time due to increased performance efficiency. Third, additional expenses can be borne by defense contractors. The CAF could adopt a policy whereby defense contractors must include some method of advanced technology training in submitting packages to the CAF for purchase.

VI. CONCLUSIONS AND RECOMMENDATIONS

While the educational environment envisioned by the concept of digital fusion is not yet a practical reality, it must be recognized by those tasked with education and training responsibilities that it is the way of the future. While training and education institutions may currently be unwilling or unable to invest in the most advanced technologies available, investment in the building block elements of modern educational technology is a must for those who would remain competitive.

The principal portion of this work has been devoted to a model system to implement computer-mediated communications in distance education for the purposes of officer training in the Chinese Air Force. In the course of research, available information led to several conclusions about the requirements, benefits, uses and direction of advanced technology applications for education and training.

Application of computer technologies in education and training is dependent on the following requirements:

- ♦ Lead time to plan
- ♦ Availability and affordability of technology
- ♦ Expertise for development and administration
- ♦ Abilities required to participate
- ♦ Overall effectiveness

Advanced training technologies can be exploited to enable the training program to deal with a variety of activities in the cognitive, psychomotor, and affective domains. The basic thrust of the technological revolution in education and training has been to make the walls of the classroom disappear. Information can be transferred and communications maintained between locations across great distances. The increasing ability of these technologies to manipulate data in formats from basic text to full-motion, live video serves to provide an exceptional opportunity to get peak efficiency and performance from a training program.

Numerous examples in this work lend additional weight to the idea that the implementation of advanced technologies in education and training is an investment that is on its way to becoming a requirement to remain competitive. The benefits and requirements of advanced training technologies are in keeping with the overall objectives of a TQL/TQM program. The implementation of such technologies is also important as a starting point (or co-justification) for other areas of activity. For example, the use of hypertext in operations manuals, in addition to training manuals, requires only the installation of a workstation or terminal in the operating area and the maintenance of the central database (i.e., a terminal connected to a central inventory for parts located in a maintenance garage) to implement a just-in-time system for ordering supplies in an operating environment. When personnel are using the same technologies to train and to perform, each activity benefits from the skills developed by the other.

Where possible, the implementation of advanced training technologies should take advantage of ROC producers for hardware and software products. In any event, a concerted effort should be made to stimulate domestic production of every item to be purchased before going abroad to fulfill procurement requirements. This will stimulate local development of the industry, and will also provide increased productivity and efficiency standards as private industry also moves to take advantage of the technology.

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